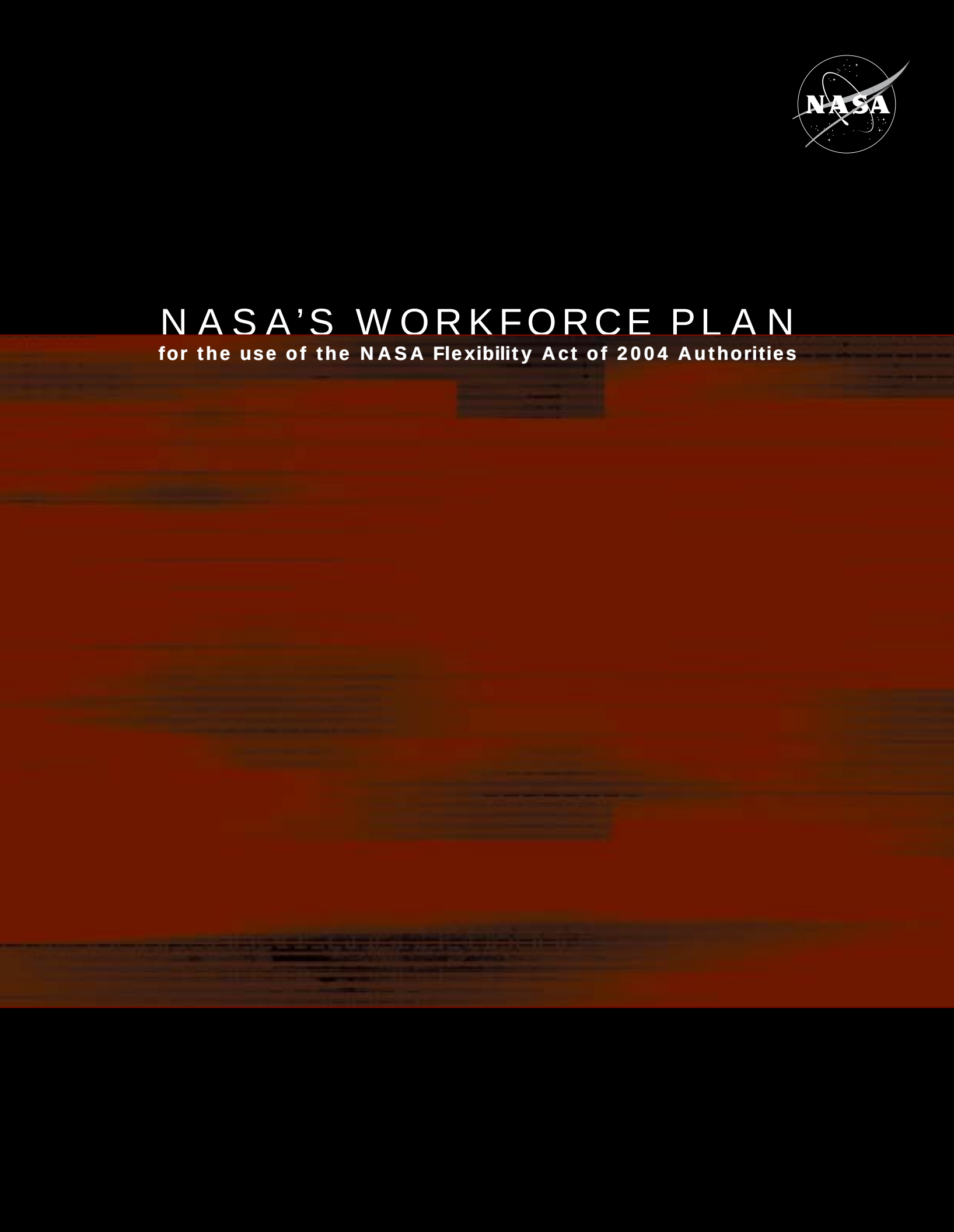


NASA'S WORKFORCE PLAN

for the use of the NASA Flexibility Act of 2004 Authorities

NASA's Workforce Plan

for the use of the NASA Flexibility Act of 2004 Authorities

The NASA Flexibility Act of 2004 (P.L. 108-201) amends title 5, United States Code, by inserting a new chapter 98 in that title that provides new authorities to the National Aeronautics and Space Administration to manage its human capital. This Act requires the Administration to submit a written Workforce Plan to Congress, approved by the Office of Personnel Management, no later than 90 days before using any of these workforce authorities.

This NASA Workforce Plan is submitted in accordance with that requirement. The plan is organized into seven sections, corresponding to the information requested in the Act, as codified in 5 U.S.C. 9802.

March 26, 2004

National Aeronautics and Space Administration Workforce Plan

I. NASA's Critical Needs

The Workforce Plan shall describe:
(1) each critical need of the Administration and the criteria used in the identification of that need;
(2) the functions, approximate number, and classes or other categories of positions or employees that address critical needs and would be eligible for each authority proposed to be exercised under this chapter, and how the exercise of those authorities with respect to the eligible positions or employees involved would address each critical need identified;
(3) any critical need identified which would not be addressed by the authorities made available under this chapter and the reasons why those needs would not be so addressed.

Background: Responding to Today's Challenges to Prevent Tomorrow's Crises

NASA faces significant human capital challenges that threaten the Agency's ability to accomplish its mission. As a world-class science and engineering agency, NASA must be able to recruit and retain top-quality scientists and engineers to accomplish its core work and remain world-class. The Agency also must have a highly competent staff to support its technical programs and address its financial, acquisition, and business management responsibilities.

In years past, NASA had little difficulty in attracting exceptional talent to the Agency. The exciting mission and the opportunity for unique hands-on experience were powerful lures. But NASA has been facing increasing difficulty in attracting and retaining a world-class, diverse workforce.

There is not a single reason or trend behind this change. Many factors contribute to this—the shrinking science and engineering pipeline, the increased competition for technical skills in today's market, the perception among many engineering students that the aerospace industry is no longer a "career of choice," and an overall declining interest in Government employment among many graduates. Because the trends are multiple, and have long-term implications for the applicant pool, it is critical that NASA take a strategic, proactive, and aggressive approach to addressing its workforce issues.

NASA's workforce demographics highlight the urgency. Within the science and engineering (S&E) workforce, the over-60 population outnumbers the under-30 population by nearly 3 to 1, and 25 percent of that workforce will be eligible to retire within 5 years. The potential departure of these individuals could deprive NASA of a wealth of knowledge, experience, and leadership essential to achieving the Agency's goals and objectives. As an agency with a highly technical mission, ensuring knowledge transfer from the senior workers to the new generation of employees is critical. For that reason, NASA must take action now to recruit new employees who can benefit from mentoring by the experienced workforce. At the same time, the Agency must be able to provide

incentives for those same experienced employees to remain as needed to mentor the new talent. In short, NASA must take action today to address tomorrow's human capital needs, or the Agency will be unable to fulfill its mission safely and successfully.

Methodology for Identifying NASA's Critical Needs

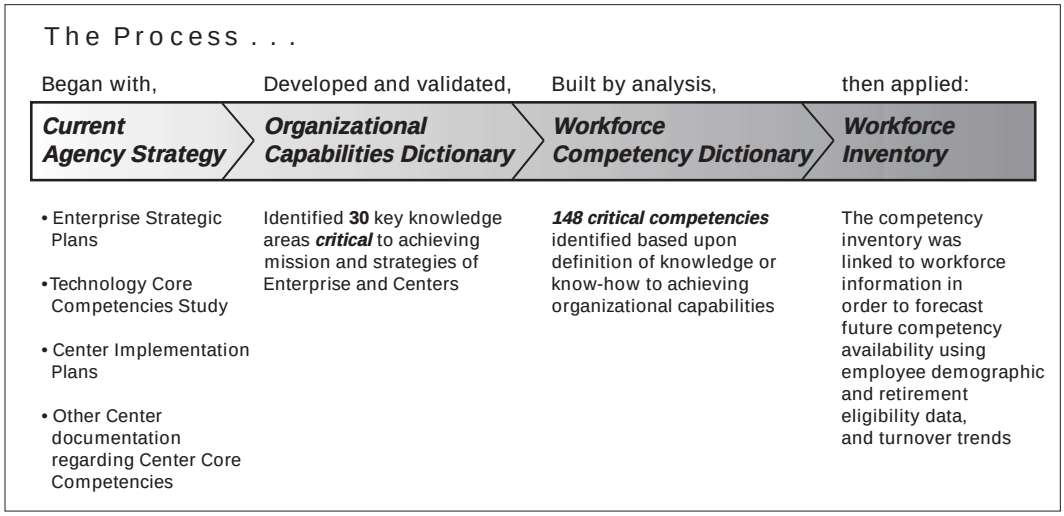
In response to these challenges, the Agency gave renewed emphasis on conducting effective workforce planning and analysis to align human resources with the Agency's mission, goals, and objectives. Toward that end, NASA has developed a Competency Management System (CMS) that, together with our newly developed and powerful Web-based analytical forecasting tools, enable the Agency to track, project, and analyze critical workforce competencies; identify current competency imbalances in the workforce relative to future needs; and assess the competency gaps (current and anticipated) to guide our recruitment, development, and redeployment initiatives. Since these tools, and the analyses resulting from them, form the basis for identifying NASA's critical needs, their development, functionality, and use are described in more detail in this section.

In developing the CMS, NASA first ensured that there was a common set of terms and definitions across the Agency that would be used to describe and identify competencies. Drawing on the Agency Strategic Plan, Enterprise Strategic Plans, Center Implementation Plans, and other documentation and studies to ensure alignment with NASA's mission, goals, and objectives, a comprehensive Organizational Capabilities Dictionary was developed. This dictionary identifies 30 key knowledge areas critical to achieving the mission and strategies of Enterprises and Centers.

The next stage of analysis went further, resulting in the development of NASA's Workforce Competency Dictionary. It drew from components inherent in the Organizational Capability definitions and Center workforce planning documents. This dictionary comprises 148 critical competencies that reflect the knowledge or know-how needed to achieve NASA mission objectives. (See Appendix A.) In this context, NASA defines "competency" as "brain-power, know-how, knowledge, or real capabilities." As appropriate, the information in the Workforce Competency Dictionary will be reviewed periodically to ensure that it is up-to-date.

Next, based on position requirements, a full inventory of competencies required within the NASA workforce was established. These competencies represented key capabilities linked to NASA's mission, goals, objectives, and business strategies.

In November 2002, attrition models were applied to the competencies in the Agency workforce inventory. Using employee demographic and retirement eligibility data, as well as turnover trends, competency areas were identified in which there was potential for higher attrition than the Agency average. This determination was based on 2 criteria—retirement eligibility greater than or equal to 40 percent over 6 years and projected attrition greater than or equal to 25 percent over 6 years. With respect to the latter criterion, "attrition" is defined as annual nonretirement losses calculated over 6 years plus retirement projections over 6 years based on NASA's historical rate of retirement.



Then, in June 2003, the Agency conducted an analysis to assess NASA's workforce requirements in several categories: (1) competencies "at risk," (2) competencies targeted for freshout recruitment, and (3) competencies linked to Space Shuttle Return to Flight objectives. The objective was to use NASA's CMS, workforce analysis automation tools, attrition modeling, and management's analysis of current and projected program requirements to identify those competencies that require immediate action to ensure that the competencies are sustained within the workforce at levels needed for mission success. The competencies in each category were ranked in terms of the number of projected Full-Time Equivalents (FTEs) needed in those areas. Below are the top 10 competencies within those categories and definitions of the criteria used to identify them.

Competencies At Risk

Competencies "at risk" represent competency areas in which additional workforce is needed to ensure minimum viability of the competency. The bench strength is weak, and strengthening it through other approaches (contractors, academia) is not a viable option. Typically, these are areas in which workforce cuts—possibly exacerbated by unanticipated attrition or difficulty in hiring for a specific competency—have been detrimental to performance.

Systems Engineering
Integration Engineering
Test Engineering
Mission Assurance
Mission Execution
Design and Development Engineering
Program/Project Management
Budgeting Management
Business IT Systems
Business Management

Competencies Targeted for Freshout Hiring

Competencies targeted for freshout hiring represent areas in which there is a need to hire freshouts in advance to ensure knowledge transfer with more experienced workers. These areas were identified by focusing on projected impacts of attrition.

Systems Engineering	Program/Project Management
Integration Engineering	Budgeting Management
Test Engineering	Administrative Support
Mission Assurance	Acquisition and Contract Management
Mission Execution	Mathematical Modeling and Analysis

Competencies Associated with Space Shuttle Return to Flight Objectives

Space Shuttle Return to Flight (RTF) competencies were identified based on the preliminary findings from the Columbia Accident Investigation Board.

Systems Engineering	Quality Engineering and Assurance
Program/Project Management	Integration Engineering
Propulsion Systems and Test	Design and Development Engineering
Safety Engineering and Assurance	Test Engineering
Mission Analysis and Planning	Mission Assurance

Competencies overlapped in the 3 categories, so the final result reflected 17 discrete competencies. Senior management reviewed the analysis to ensure that it included competency areas needed for new initiatives (or initiatives involving new technology) that might not otherwise be captured through the workforce analysis tools. That review resulted in adding two additional competencies—nuclear engineering and human factors.

From these 19 competencies, management identified 10 as competencies that reflect needs across the Agency and therefore merit special focus in terms of the Agency's recruitment strategy. These were referred to as NASA's "corporate competencies."

Corporate Competencies

Systems Engineering	Human Factors
Integration Engineering	Design and Development Engineering
Test Engineering	Quality Engineering and Assurance
Mission Assurance	Mission Execution
Nuclear Engineering	Business Management

The above analysis identifies the "top 10" competencies within the different categories on the basis of projected numbers of FTEs needed (constrained by FY09 project budget

levels). Consequently, it does not capture all at-risk competencies that are important to individual Centers. Although the number of FTEs associated with a specific competency may be small relative to the other competencies, the possibility of a "single point failure" may be even greater if the employees associated with that competency leave NASA unexpectedly. For Centers with exceptional recruitment challenges due to their location or environment—such as Ames Research Center and Dryden Flight Research Center—a lack of bench strength in highly technical areas can greatly affect mission accomplishment. For that reason, those Center-specific at-risk competencies that fall below the "top 10" criterion are included as critical:

Additional At-Risk Competencies Relative to Specific Centers

Intelligence/Adaptive Systems
Institutional Facilities Planning
Institutional Facilities Operations
Fundamental Human Factors Research
Aerodynamics
Advanced Experimentation and Testing Technologies
Engineering and Science Support
Electrical and Electronic Systems
Advanced In-Space Propulsion
Communications Networks and Engineering
Computer Systems and Engineering
Flight and Ground Data Systems
Financial Management
Human Resources
Public Communications and Outreach
Legal
Advanced Mission Analysis

This process resulted in identifying a total of 36 competencies (of the 148 competencies from the NASA Workforce Competency Dictionary) on which NASA must focus its recruitment, retention, and development efforts to meet its human capital challenges. These are the Agency's most significant competency requirements and represent NASA's critical needs.

A summary chart identifying each competency by the five categories discussed on the preceding pages (corporate, at risk, freshout needs, return to flight, and Center-specific at risk) follows.

Competencies Representing NASA's Critical Needs

4th Quarter, FY 2003 Analysis

Competency	Category of Competency				
	Corporate	At Risk	RTF	Freshout	At Risk (Center Specific)
Systems Engineering	X	X	X	X	
Integration Engineering	X	X	X	X	
Test Engineering	X	X	X	X	
Mission Assurance	X	X	X	X	
Human Factors	X				
Nuclear Engineering	X				
Design and Development Engineering	X	X	X		
Quality Engineering and Assurance	X		X		
Business Management *	X	X			
Mission Execution	X	X		X	
Program/Project Management		X	X	X	
Business IT Systems		X			
Budgeting Management *		X		X	
Propulsion Systems and Testing			X		
Safety Engineering and Assurance			X		
Mission Analysis and Planning			X		
Administrative Support (will be excluded)				X	
Acquisition and Contract Management *				X	
Mathematical Modeling and Analysis				X	
Intelligent/Adaptive Systems					X
Institutional Facilities Planning					X
Institutional Facilities Operations					X
Fundamental Human Factors Research					X
Engineering and Science Support					X
Electrical and Electronics Systems					X
Communications Networks and Engineering					X
Advanced In-Space Propulsion					X
Computer Systems and Engineering					X
Financial Management *					X
Flight and Ground Data Systems					X
Human Resources *					X
Public Communications and Outreach *					X
Legal *					X
Advanced Mission Analysis					X
Advanced Experimentation and Testing Technology					X
Aerodynamics					X

The competencies resulting from this analysis include several that normally would not be considered within the scope of important safety, management, engineering, research, science, or operations requirement that further defines "critical need" in the NASA Flexibility Act of 2004. For that reason, those competencies that do not fall within that description will not be considered critical needs for purposes of applying this Act. Specifically, the competency of "Administrative Support" is excluded, as are nonmanagement positions associated with the asterisked administrative competencies.

It should be noted that the fact that a competency reflects a critical need does not necessarily mean that the use of the special workforce flexibilities or incentives is appropriate in every recruitment, retention, or reshaping action taken to address that need. Labor market dynamics at a particular location and time will influence the tools that need to be used. Each case will be assessed on its individual merits to determine whether it is necessary or appropriate to use a specific incentive. For some competencies at some Centers the existing flexibilities and incentives may be adequate to hire or retain individuals. Generally, NASA anticipates using the new flexibilities predominantly in addressing science and engineering critical needs.

As part of NASA's Strategic Workforce Management Process, the Agency will review the current core competencies annually, identify workforce competencies required for future mission success based on budgeted programs, and develop projections of competencies (and quantities) for programs and functions 5 years into the future.

Critical Needs: Identifying Functions, Classes, or Other Categories of Positions/Employees

Occupational series—Employees are appointed and compensated on the basis of Office of Personnel Management (OPM) occupational series (in addition to other factors). Also, workforce reports on Federal civil servants typically convey information in terms of these occupational categories. Although NASA's competency approach provides finer distinctions than the broad occupational categories, "crosswalking" the competencies to those series will prove useful in many contexts. This crosswalk is found in Appendix B. The chart indicates the occupational series with which a competency is most likely to be associated within NASA. In most cases, the competency may be found in positions classified to multiple series. For example, the competency of "systems engineering" may be associated with positions that are classified in four different series: General Engineer, Computer Engineer, Electronics Engineer, and Aerospace Engineer.

The determinations are based on several factors: the series of current NASA employees for whom the competency is considered primary; comparison of the competency definition against OPM's occupational series definitions; and identification of the majors of undergraduate and graduate students who are working in the specified competency areas.

Level—NASA's critical needs correspond to positions at multiple levels—entry, mid, and senior level. NASA's legislative proposals specifically were developed to address that fact.

Type of appointment—NASA strives to adapt to the changing needs of the future by creating and strengthening institutional flexibility. This requires developing an appropriate mix of permanent and nonpermanent (i.e., temporary or term) civil servants. NASA will use the authorities available in the NASA Flexibility Act of 2004 to attract and retain both full-time permanent and other than full-time permanent employees to meet critical needs.

Critical Needs: Identifying Approximate Number of Employees/Positions

Identifying the number of employees or positions associated with the critical competencies identified above is influenced by changes in major programs and projects, budget considerations, and attrition patterns. Nevertheless, NASA is engaged in an effort to make as precise forecasts as possible using the CMS and other workforce management tools. As a baseline, we are using information from each FY 2003 program and project to identify how much time in terms of Full-Time Equivalents (FTEs) was associated with each competency.

Since the CMS is relatively new, initial data entry regarding competencies associated with FTEs may reflect some inaccuracies due to the lack of individual competency data at some Centers, requiring reliance exclusively on position-based data. For that reason, the FTEs are expressed as ranges. These potential inaccuracies will diminish, however, as NASA nears completion of a significant enhancement to the CMS—incorporating data on the personal competency portfolio for each NASA employee. This data will be a valuable supplement to the existing data that reflects competencies associated with the positions of the NASA workforce. Several Centers have completed this enhancement, and all Centers should finish doing so by the summer of 2004. Its usefulness became apparent recently at one Center facing a program cancellation. Based on CMS data, the competency data pertaining to the employees affected by the program cancellation was used to determine viable placement opportunities for those employees, and all employees were placed.

Data identifying competencies with FTEs, expressed as ranges, follows.

Competency	FY 2003 FTEs
Program/Project Management	1,160–1,185
Engineering and Science Support	565–590
Acquisition and Contract Management	415–440
Business Management	380–405
Mission Execution	380–405
Test Engineering	320–345
Systems Engineering	300–335
Integration Engineering	210–235
Budgeting Management	210–235
Propulsion Systems and Testing	210–235
Business IT Systems	200–225
Design and Development Engineering	180–195
Quality Engineering and Assurance	170–185
Financial Management	160–175
Electrical and Electronic Systems	140–155
Human Resources	135–150
Safety Engineering and Assurance	120–130
Flight and Ground Data Systems	110–125
Public Communications and Outreach	95–110
Computer Systems and Engineering	95–110
Mathematical Modeling and Analysis	85–95
Intelligent/Adaptive Systems	80–90
Communication Networks and Engineering	75–85
Mission Assurance	65–75
Advanced Experimentation and Testing Techniques	55–65
Mission Analysis and Planning	50–60
Legal	40–50
Institutional Facilities Planning	30–40
Human Factors Engineering	30–40
Fundamental Human Factors Research	20–30
Institutional Facilities Operations	20–30
Aerodynamics	15–25
Advanced Mission Analysis	10–20
Advanced In-Space Propulsion	10–20
Nuclear Engineering	1–10

To address some of the Agency's immediate critical needs, NASA initiated an aggressive corporate recruitment effort to address our 10 critical corporate competency needs. This effort, which supplements other recruitment efforts in which the Centers are engaged, established specific hiring goals for FY04 and FY05 within the NASA baseline budget. For FY04, the target is 150 and for FY 2005, the target is 100. NASA anticipates filling 110 of the FY04 hires with freshouts and filling 75 of the FY05 hires with freshouts. Freshout hiring prior to the actual departure of current employees is a key emphasis in NASA's hiring initiatives over the next 5 years. The loss of intellectual capital and management talent in the absence of mentoring a younger generation threatens program execution.

Although the individual Centers' freshout recruitment needs with respect to the corporate competencies differ, each Center's top 3 needs (in terms of FTEs) are among the 10 corporate competencies.

The Agency now is in the process of working with Centers to estimate Agencywide needs for FY 2004 through FY 2010. The CMS and NASA's workforce planning and analysis tools will be used to assess competencies critical to the new vision for U.S. space exploration and the extent to which those competencies exist within the Agency. We anticipate completing an analysis of competency needs and gaps and FTEs/budget linked to new direction programs in May. As appropriate, the data in this section will be modified to reflect any changes in the identification of NASA's critical needs and submitted to Congress in accordance with the provisions of the NASA Flexibility Act of 2004.

Using the Workforce Authorities to Address NASA's Critical Needs

The workforce authorities in the NASA Flexibility Act of 2004 provide versatile tools to address the Agency's critical competency needs. This versatility is vitally important, since different solutions are needed to address the multiple human capital challenges facing the Centers—challenges that are shaped by each Center's demographics, local labor market, and program/project shifts. As part of the workforce analysis conducted in June 2003, senior management considered these workforce authorities and how they could be used to address the workforce needs across the Agency. Below is a summary of the observations that were made.

For Centers anticipating higher-than-normal attrition and/or the need to recruit hard-to-fill competencies, there will be a strong need for the recruitment flexibilities and incentives. The use of the individual flexibilities is likely to vary, depending upon the category of employee being recruited—freshout, mid, or senior level.

- The recruitment, redesignation, and relocation bonuses will be used as hiring incentives when necessary to attract exceptional talent to the Agency. Recruitment bonuses may be paid to individuals who are newly appointed as Federal employees, while redesignation bonuses may be paid to employees of other Federal agencies appointed to NASA positions in the same geographic area. Relocation bonuses may be paid to current Federal employees (including a NASA employee) who are required to relocate to a different geographic area to accept a NASA position. Historically, recruitment and relocation bonuses have been used across a variety of occupations, grade levels, and geographic locations.

- The enhanced annual leave provision and enhanced travel and relocation benefits will be very effective in attracting talent to the Agency, particularly at the mid and senior levels.

- Recruitment for expertise of a world-class nature is always difficult, since the private sector—including academia—has greater flexibility in offering attractive financial rewards. The pay authority for critical positions will allow NASA to compete more successfully to attract the exceptional talent that the Agency needs.

- Recognizing that effective recruitment methods are as important to success as the recruitment incentives, management anticipates using the Distinguished Scholar Appointment authority to address the need for permanent freshout hires. This streamlined hiring authority will enable the Agency to target the outstanding graduates when filling professional and scientific positions at the entry and intermediate levels.

Retention strategies are critical in a knowledge-based agency like NASA, particularly at a time in which the older technical workforce outnumbers the younger technical workforce so dramatically. As a result of a decade of downsizing, many Centers have found that they have a generation gap that has created a discontinuity between the younger members of the workforce and those who normally would have preceded them and been their primary mentors. Until this gap is corrected, retention bonuses will provide more effective incentives to employees with critical, unique expertise to continue to work and transfer their knowledge to others in the workforce. NASA's critical pay authority may be an effective means of retaining world-class talent as well.

The qualifications pay authority will permit NASA to *leverage the expertise of its workforce* by permitting adjustments in an employee's pay when assigning the employee to a different position, based on his or her unusually high or unique qualifications or a special need of the Agency. This tool was specifically designed to address critical needs of NASA; it provides an incentive for an employee to accept a position or new responsibilities for which he or she would not otherwise be interested and available, but for which the employee has exceptional or unique qualifications.

NASA recognizes the need to develop a more flexible workforce. The provision to permit longer-duration term appointments and to authorize conversion of term employees to permanent appointments will provide the Agency with greater flexibility in tailoring its workforce for program/project changes and will facilitate placing term employees in whom we have invested training into permanent vacancies that may occur. It also is possible that these two features (length of appointment and conversion eligibility) may make the concept of term appointments more attractive to potential applicants and thereby provide a more robust labor pool for the Agency.

Senior Executive Service (SES) members are critical to accomplishing the Agency's mission. Management recognizes that over half of the SES workforce is eligible to retire within the next 5 years. The SES limited appointment authority will provide NASA with a more effective means of responding to short-term staffing needs associated with such positions.

In yet other areas, NASA needs the ability to *leverage external expertise*. Enhancing the Intergovernmental Personnel Act authority to permit assignments up to 6 years, rather than 4, will facilitate knowledge transfer—an important goal of an agency that must sustain its intellectual capital. This flexibility will allow individuals from academia or nonprofit institutions to continue to support long-term projects when the need for continuity is critical.

Recognizing that NASA's long-term ability to recruit highly qualified technical personnel depends on a robust pipeline of graduates, NASA will use the Science and Technology Scholarship Program to guide students toward careers in academic disciplines needed by the Agency. This is an important investment for the Agency and, ultimately, for the country.

In summary, based upon the preliminary assessment made by senior management in June 2003, NASA anticipates that the authorities provided in the NASA Flexibility Act of 2004 will be very effective tools in addressing NASA's current and projected workforce critical needs. There are no identified critical needs, at this time, that we have reason to believe cannot be addressed by the workforce flexibilities. Since the ability to attract and retain talent is a function of labor market dynamics over which NASA has no control, we cannot predict the extent to which these tools will be effective in the future. As indicated in other sections of this Workforce Plan, the Agency will maintain data on the use of these authorities in order to assess their impact in addressing workforce needs.

It also is important to recognize that these authorities focus primarily on enhancing the compensation-related benefits for employees and improving the processes for hiring and placing the employees into positions. They do not affect the nature of the work done in NASA or the work environment. Ultimately, NASA's ability to provide challenging and rewarding work in a creative, professional, and collaborate environment is critical to the Agency's ability to attract the best and the brightest.

II. Criteria for Using Recruitment, Redesignation, Relocation, and Retention Bonuses

The Workforce Plan shall describe:
the specific criteria to be used in determining which individuals may receive the benefits described in sections 9804 and 9805 (including the criteria for granting bonuses in the absence of a critical need) and how the level of those benefits will be determined.

Section A: Recruitment, Redesignation, and Relocation Bonuses

The NASA Flexibility Act of 2004 (P.L. 108–201) as codified in 5 U.S.C. 9804 provides for payment of:

- Recruitment Bonus—Paid to an individual newly appointed as an employee of the Federal Government. The term "newly appointed" will be applied as defined in 5 CFR 575.103.

- Redesignation Bonus—Paid to an employee of another Federal agency in the Executive, Legislative, or Judicial Branch of the Federal Government who is appointed to a NASA position in the same geographic area.

- Relocation Bonus—Paid to a current Federal employee who is required to relocate to a different geographic area to accept a NASA position.

General Requirements

- All bonuses are to be used only in situations where the position would likely, in the absence of a bonus, be difficult to fill.

- Bonuses are appropriate when an individual selected for a difficult-to-fill position indicates an unwillingness to accept because of insufficient compensation. Before offering a bonus, other incentives and alternatives should be considered (e.g., superior qualifications appointments and qualifications pay) either in lieu of or in conjunction with bonuses.

- All bonuses are to be offered in accordance with merit principles, and shall be in amounts, and under terms, commensurate with the needs of the Agency.

- Approving officials will assure that bonus packages and associated service agreements provide for a maximum return on the Agency investment.

- Approvals must be based on written documentation that addresses the requisite criteria. The documentation must indicate clearly whether the position addresses a critical need.

- No more than 25 percent of the total amount of bonuses awarded under this provision shall be awarded to supervisors or management officials.

- Payment of a bonus under these provisions is contingent upon the employee signing a service agreement with the Agency.

Determining Basic Eligibility: Any case in which the Agency is considering paying a bonus under these provisions must be evaluated using the basic eligibility criteria outlined below in the matrix and supporting information. If the situation does not meet the minimum requirements as identified below, no bonus payment may be made.

BASIC ELIGIBILITY CRITERIA
Recruitment, Redesignation, and Relocation Bonuses

Criterion	Definition	Elements
Degree of Difficulty in Recruitment	Extent to which quality candidates possessing the required skills and experience are available in the labor force.	(a) Recent recruitment efforts for comparable positions in the same geographic area demonstrate that it is difficult to find well-qualified candidates. (b) Positions requiring the skills are often vacant, and fill times are prolonged. (c) Positions requiring the skills typically have a high turnover rate. (d) Labor market trends demonstrate that the Agency is likely to experience difficulty in finding well-qualified candidates now and/or in the future. (e) Candidates offered positions requiring these skills frequently decline the job offer. (f) Position is in a new or emerging technical area where the organization has a demand for the skills, but little recruitment history.

Evaluating the Degree of Difficulty in Hiring: In order to meet the basic eligibility requirements for a bonus under this section, the position normally must meet any two of elements (a) through (e) or element (f).

If the position does not meet at least two of the elements identified above, but presents issues of equivalent difficulty in the recruitment process, they may be used in lieu of elements (a) through (e) in justifying payment of a bonus.

Each case file must include documentation explaining and supporting the determination that the individual meets the basic eligibility requirements for payment of a bonus. Where a position is described as having a prolonged fill time or a high turnover rate, the justification must include information supporting that determination in the context of the specific type of work involved.

Determining the Level of the Bonus: Whenever there has been a positive determination of bonus eligibility, a further determination must be made as to the appropriate level (amount) of the bonus. The determination must be consistent with these requirements and general principles:

- Individuals in positions addressing a *critical need*, as defined in this plan, are eligible for a bonus up to a maximum of 50 percent of annual rate of basic pay (including comparability payments authorized under sections 5304 and 5304a of title 5, U.S.C) at the beginning of the service period multiplied by the service period. (Note: The total bonus payment may not exceed 100 percent of the annual rate of basic pay as of the beginning of the service period. Therefore, any individual receiving the maximum amount of the bonus will incur a service obligation of 2 years.)

- Individuals in positions *not* requiring competencies defined as critical needs are eligible for a bonus up to a maximum of 25 percent of the employee's annual rate of basic pay (excluding comparability payments authorized under sections 5304 and 5304a of title 5, U.S.C) as of the beginning of the service period.

- There is no entitlement, either implied or explicit, for an employee to receive the maximum bonus allowable under the law.

- Even where the evaluation of the criteria may support payment of a high bonus, the organization will pay a smaller bonus if such an amount is sufficient to secure a candidate's acceptance.

Within the parameters identified above, the guidelines in the following matrix should be used to determine the appropriate maximum level of bonus payment.

BONUS LEVEL EVALUATION CRITERIA
Recruitment, Redesignation, and Relocation Bonuses

Criteria	Definitions	Elements
1. Impact of Market Forces	Extent to which a specific candidate is likely to accept a job offer.	(a) Applicant provides evidence of a higher competing offer of employment. (b) Candidate's current salary is higher than the salary of the position being offered. (c) Salaries in the candidate's field are higher than for those of comparable positions at this location, as demonstrated by salary surveys or other objective evidence.
2. Individual Attributes	Extent to which the individual possesses competencies that will enhance the Agency's ability to accomplish its mission.	(a) Individual's work experience and/or academic preparation have an unusually close and direct relevance to the position being filled. (b) Individual has contributed to the expansion of the body of knowledge in the professional field as evidenced by research publications and/or leadership on professional panels, committees, and/or professional and honorary societies. (c) Individual's professional contributions have been formally recognized in the form of awards, citations, and/or commendations. (d) Individual brings new skills or perspectives not previously available, as demonstrated by unique or unconventional professional achievements. (e) FRESHOUTS ONLY: Candidate possesses a high level and quality of educational attainment compared to the minimum educational requirements of the position. The phrase "high level and quality" is defined as an individual who has at least a 3.5 GPA in the academic discipline related to the position being filled.

Criteria in the matrix provide key representative examples of elements that may be used to establish the level of the bonus payment. They are not, however, all-inclusive. Other issues of commensurate significance may be used, when documented, to establish the level of the bonus.

Candidates Meeting Only Basic Eligibility: In some cases, candidates may meet basic bonus eligibility, but do not meet any of the criteria in the matrix above or other comparable elements. Such individuals will be paid bonuses that do not exceed one-third of the maximum percentage allowable under the law. That is, bonuses paid to candidates for critical need positions will not exceed approximately 17 percent (out of a maximum 50 percent) of basic salary; bonuses paid to candidates for positions not meeting a critical need will not exceed approximately 8 percent (out of a maximum 25 percent) of basic salary.

Criterion 1, Impact of Market Forces: Candidates who meet one or more of these or comparable elements may be offered a bonus sufficiently high enough to be competitive with the individual's other employment alternative(s) and thereby create an incentive to accept the NASA position.

Criterion 2, Individual Attributes:

- Candidates who meet Criterion 1, and who also possess skills and knowledge with the potential to substantially enhance NASA's capabilities and reputation by meeting one or more of the elements under Criterion 2 or equivalent elements, may be paid a bonus up to the maximum amount allowable under the law.

- Candidates who do not meet Criterion 1, but who demonstrate a high level of professional achievement, comparable to the elements outlined under Criterion 2 of the matrix, may be awarded bonuses higher than the minimum one-third of the maximum allowable under the law. The documentation must demonstrate a level of accomplishment sufficient to justify the percentage being offered.

All bonus level determinations beyond the minimum must be supported by documentation of the circumstances warranting the higher-level payment.

Section B: Retention Bonuses

The NASA Flexibility Act of 2004 (P.L. 108–201) as codified in 5 U.S.C. 9805 provides for payment of retention bonuses. These may be paid to NASA employees who are likely to leave the Agency for any reason. This includes individuals leaving NASA to accept positions outside the Federal Government *or* individuals leaving NASA to accept positions with other Federal agencies.

General Requirements

- Retention bonuses are to be used in situations where the employee is likely to leave NASA, and it is essential to retain the employee's services because of the employee's unusually high or unique qualifications or because of a special Agency need that makes it essential to retain the employee.

- Retention bonuses are to be offered in accordance with merit principles and shall be in amounts, and under terms, commensurate with the needs of the Agency.

- An employee may not receive a retention bonus for any period of time covered under a service agreement under section 9804 of the NASA Flexibility Act of 2004 or under section 5753 of title 5, United States Code.

- Approving officials will assure that bonus packages and associated service agreements (if any) provide for a maximum return on the Agency investment.

- No more than 25 percent of the total annual amount of bonuses awarded under this provision shall be awarded to supervisors or management officials.

- Approval must be based on written documentation that addresses the requisite criteria. The documentation must specifically identify whether or not the individual occupies a position supporting a competency designated as a critical need.

- Unless the employee is paid the full percentage of the bonus in biweekly installments, payment is contingent upon the employee signing a service agreement with the Agency.

- Individuals who are given a retention bonus under terms not requiring a service agreement are subject to annual verification. The approving official must certify that the employee/position continue to meet the criteria for payment of the bonus.

Determining Basic Eligibility: Any case in which the Agency is considering paying a bonus under these provisions must be evaluated using the basic eligibility criteria in the matrix below and supporting information. If the situation does not meet the minimum requirements as identified on the following page, no bonus payment may be made.

All cases must meet Criterion 1 *and* meet Criterion 2 or Criterion 3.

BASIC ELIGIBILITY CRITERIA
Retention Bonuses

Criteria	Definitions	Elements
1. Likelihood of Employee Loss	Extent to which the employee is likely to leave the Agency.	(a) The employee has expressed a specific intention of leaving the Agency.
2. Program Impact	Extent to which the employee's departure affects Agency projects or programs.	(a) The employee has extensive subject-matter expertise and experience in a project or program area. (b) The employee serves as a key mentor and knowledge base for less experienced employees within the organization.
3. Degree of Difficulty in Replacement	Extent to which quality candidates possessing the required skills and experience are available in the labor force.	(a) Recent recruitment efforts for comparable positions in the same geographic area demonstrate that it is difficult to find well-qualified candidates. (b) Positions requiring the skills are often vacant, and fill times are prolonged. (c) Positions requiring the skills typically have a high turnover rate. (d) Labor market trends demonstrate that the Agency is likely to experience difficulty in finding well-qualified candidates now and/or in the future. (e) Candidates offered positions requiring these skills frequently decline the job offer. (f) Position is in a relatively new or emerging technical area where there is limited recruitment history.

- **Criterion 1, Likelihood of Employee Loss:** In order for the Agency to offer a retention bonus, there must be a likelihood that the employee would leave in the absence of such a payment. Eligibility is, therefore, contingent on the employee meeting this criterion.

- **Criterion 2, Program Impact:** Situations meeting this criterion must meet at least one of the two elements described in the matrix above.

- **Criterion 3, Degree of Difficulty in Replacement:** The contention that the employee possesses unique or high-level skills must be supported by evidence that, should the employee leave, the Agency would find it difficult to replace him or her with someone of equal caliber. The situation normally will meet at least two of elements (a) through (e) *or* element (f).

If the position does not meet at least two of the elements identified in Criterion 3 but presents issues of equivalent difficulty in the replacement process, they may be used in lieu of elements (a) through (e) in justifying payment of a bonus.

Each case file must include documentation explaining and supporting the basis of payment eligibility. Where a position is described as having a prolonged fill time or a high turnover rate, the justification must include information supporting that determination in the context of the specific type of work involved.

Determining the Level of the Bonus: Whenever there has been a positive determination of bonus eligibility, a further determination must be made as to the appropriate level of bonus payment. The determination must be consistent with the requirements and general principles below.

General Principles

- Individuals in positions addressing a *critical need*, as identified in this plan, are eligible for a bonus up to a maximum of 50 percent of the annual rate of basic pay (including comparability payments authorized under sections 5304 and 5304a of title 5, U.S.C.). This shall be interpreted to mean that no employee may receive, in total retention payments, more than 50 percent of the annual rate of basic pay (including comparability payments) during the course of a year.

- Individuals in positions that are *not* identified as addressing a critical need are eligible for a bonus up to a maximum of 25 percent of the employee's annual rate of basic pay (excluding comparability payments authorized under sections 5304 and 5304a of title 5, U.S.C.).

- There is no entitlement, either implied or explicit, for an employee to receive the maximum bonus allowable under the law.

- Even where evaluation of the criteria may support payment of a high bonus, the organization will pay a smaller bonus if such an amount is sufficient to induce the individual to stay, or if budget or other appropriate concerns so dictate.

Bonus Level Assessment

The matrix on the following page is to be used in determining the appropriate maximum level of bonus payment. Criteria in the matrix provide key representative examples of elements that may be used to establish the level of the bonus payment. They are not, however, all-inclusive. Other issues of commensurate significance may be used, when documented, to establish the level of the bonus.

BONUS LEVEL EVALUATION CRITERIA
Retention Bonuses

Criteria	Definitions	Elements
1. Impact of Market Forces	Extent to which an employee is likely to remain in his or her position.	(a) The employee provides evidence of a substantially higher competing offer of employment. (b) Salaries in the employee's field are higher than those of comparable position at the location where the employee works, as demonstrated by salary surveys or other objective evidence.
2. Individual Attributes	Extent to which the employee possesses skills and competencies of an exceptionally high or unique nature.	(a) Employee possesses skills or perspectives that are unique in the workforce. (b) Employee has contributed to the expansion of the body of knowledge in the professional field as seen by research publications and/or leadership on professional panels, committees, and/or professional and honorary societies. (c) Employee's professional contributions have been formally recognized by performance awards and/or awards, citations, or commendations from professional groups.

- **Candidates Meeting Only Basic Eligibility:** In some cases, candidates may meet basic retention bonus eligibility, but do not meet any of the criteria in the matrix or other comparable elements. Such individuals will be paid bonuses that do not exceed one-third of the maximum percentage allowable under the law. That is, bonuses paid to candidates in critical need positions will not exceed approximately 17 percent of basic salary (out of a maximum 50 percent); bonuses paid to candidates in positions not meeting a critical need will not exceed approximately 8 percent of basic salary (out of a maximum 25 percent).

- **Criterion 1, Impact of Market Forces:** Candidates who meet one or both of these or comparable elements may be offered a bonus sufficiently high enough to be competitive with the individual's other alternative(s) and to create an incentive to remain in the NASA position.

- **Criterion 2, Individual Attributes:**

  - *Candidates who meet Criterion 1,* and who also possess skills and knowledge that substantially enhance NASA's capabilities and reputation by meeting one or more of the elements under Criterion 2 or equivalent elements, may be paid a bonus up to the maximum amount allowable under the law.

- *Candidates who do not meet Criterion 1*, but who demonstrate a high level of professional achievement comparable to the elements outlined under Criterion 2 of the matrix, may be awarded bonuses higher than the minimum one-third of the maximum allowed for meeting basic eligibility only as described above. The documentation must demonstrate a level of accomplishment sufficient to justify the percentage being offered.

All bonus level determinations beyond the minimum must be supported by documentation of the circumstances warranting the higher-level payment.

III. Safeguards to Protect Merit Principles

The Workforce Plan shall describe:
the safeguards or other measures that will be applied to ensure that this chapter is carried out in a manner consistent with merit system principles.

NASA's Continuing Commitment

NASA has a longstanding and continuing commitment to compliance with merit system principles in all its human capital activities. Our Strategic Human Capital Plan reinforces this commitment through its emphasis on the alignment between Agency goals and effective management of employees, on the establishment of a performance culture based on results, motivation, and fairness, and on the goal of attracting and retaining a diverse and highly skilled workforce.

NASA has current evaluation systems in place to ensure compliance with merit system principles. Since the early 1990s, we have operated a compliance self-assessment system that evaluates and advances our human capital agenda through cyclical fact-based evaluation. NASA's self-assessment system is a structured process for measuring Agency human capital practices and ensuring they are merit-based and linked to the Agency's vision, mission, strategic objectives, and expectations.

External reviews, such as those conducted by the Office of Personnel Management (OPM), provide an additional mechanism for evaluating compliance with merit system principles. OPM conducts cyclical Agencywide and delegated examining reviews periodically to ensure not only that our employment policies and practices are in compliance with the merit systems principles and with all related legal and regulatory requirements, but that they are efficient and effective. OPM evaluators share their findings with NASA representatives, thus providing the necessary feedback for highlighting those areas that can be shared as best practices and strengthening any that may be deficient.

To reinforce our commitment to merit systems principles, NASA is participating in the U.S. Office of Special Counsel (OSC) certification program. This is a voluntary program to assist agencies in informing employees and managers about their rights and responsibilities under Federal law. Among other things, participating agencies must train all supervisors to ensure their understanding of prohibited personnel practices and whistleblower protections. On January 14, 2004, NASA was certified by OSC as having completed its participation in OSC's 5 U.S.C. 2302(c) Certification Program.

Existing Protections Remain in Effect

The authorities conferred by this legislation do not in any way eliminate or diminish existing requirements for merit-based decisionmaking. They are by design expansions of existing authorities; the other current requirements and procedures for use of those authorities remain in place. Among these are existing requirements for competition and

affirmative employment. Further, NASA's expanded authorities do not provide for—nor did NASA seek—exemptions from employee protections contained in title 5 of the United States Code. Our employees' rights and protections in the areas of nondiscrimination, appeals and grievances, whistleblower protection, and labor-management relations are unchanged.

Merit System Compliance Is Enhanced

The expanded authorities will enhance NASA's ability to conduct human capital management activities in compliance with merit system principles. Our need to attract a highly skilled, diverse, and productive workforce is now supported by new recruitment incentives and streamlined procedures that will allow NASA to place a renewed emphasis on hiring the "best and brightest" candidates for employment and building a workforce representative of the Nation's diversity. Similarly, the expanded bonuses and critical pay authority will allow us to recognize excellent performance in a more meaningful way.

Safeguards Included in Implementation Plans

NASA's plans for implementing the specific authorities will focus on opportunities for proactive application of merit principles. For example, the criteria for recruitment, redesignation, relocation, and retention bonuses (described in Section II of this plan) have been developed with the intent of ensuring fairness and equity in the identification of bonus recipients. This focus extends to the other authorities as well, and is reflected in specific implementation plans and policy documents.

Review and Evaluation

NASA will address merit system compliance as an integral part of our plan to evaluate the effectiveness of these authorities. (The issue of assessment methods is discussed further in Section V of this plan.) We will use information derived from periodic assessments to evaluate merit system compliance and to make changes in policies or procedures where a need for improvement is indicated.

IV. Notification to Employees

The Workforce Plan shall describe:
the means by which NASA employees will be afforded the notification required by the Workforce Plan, including notification of any subsequent modifications to the plan.

NASA is fully committed to communicating and consulting with its employees and employee representatives regarding the Workforce Plan and the policies and procedures associated with implementing the authorities contained in the NASA Flexibility Act of 2004.

Toward that end, a Human Capital Legislation Implementation Team with representatives from all NASA Centers was formed in the late summer of 2003 in anticipation of enactment of NASA's human capital legislation. Its charter was to develop the Agency's Workforce Plan and draft the Agency policies and procedures needed to implement the individual authorities. In forming this team, NASA contacted the national representatives for the American Federation of Government Employees (AFGE) and the International Federation of Professional and Technical Engineers (IFPTE) and invited them to participate on the Legislation Implementation Team. IFPTE accepted the offer and provided a member to serve on the team.

As part of this effort, the Implementation Team developed a Communications Plan that outlined the actions to be taken to ensure appropriate notification and sharing of information with employees and employee representatives. (See Appendix C.) This plan serves as a comprehensive guide for the Agency to follow in its change management activities associated with the implementation of the NASA Flexibility Act of 2004. It addresses three critical components essential to successful change management: the tools and methods for communication; the roles and responsibilities of individuals; and the scope and content of the material being disseminated.

As the Communication Plan indicates, NASA will communicate information regarding the Workforce Plan and workforce authorities to employees through a variety of media including official written communications, a Web site devoted to the NASA Flexibility Act of 2004 (*http://nasapeople.nasa.gov/hclwp/index.htm*), "town hall" meetings, and other forums. To ensure that the information is comprehensive yet understandable, the communication materials will include the official documents (e.g., the Act itself and NASA written policies), fact sheets, Frequently Asked Questions, and briefing charts.

A Change Management Subteam has been established to ensure that the strategies outlined in the Communications Plan are executed successfully, including providing appropriate employee notification as required by the Act.

V. Assessing the Success of the Workforce Authorities

The Workforce Plan shall describe:
the methods that will be used to determine if the workforce authorities exercised under this chapter have successfully addressed each critical need identified.

In order to assess the effectiveness of the authorities provided in the NASA Flexibility Act of 2004, the Agency will measure the extent to which their use closes current or projected gaps of competencies needed to meet mission objectives. This is the fundamental measure of success.

To make this assessment, NASA will institute processes and procedures to capture and analyze the following categories of information (at a minimum) pertaining to hiring and retention efforts:

- Instances in which each authority was used to address a critical need as identified through NASA's Competency Management System (relative to the instances in which the authority was used otherwise),

- Declination rate among selectees who were offered jobs associated with critical needs when one or more of the workforce authorities were used in conjunction with the job offer, and

- Turnover trends among employees in positions representing critical needs (and the percentage of those employees who had been hired/retained/redeployed through the use of one of the authorities).

As appropriate, NASA will analyze the impact of the use of these authorities on workforce demographics.

In order to comply with reporting requirements and to provide a basis for additional analyses of the effectiveness of the authorities, data will be maintained on each instance of the use of an authority so that NASA can determine the scope of its use and where it has been most effective.

Data from the Competency Management System, built on common Agencywide terminology and an inventory of current workforce competencies, will aid NASA in tracking its success in using the workforce flexibilities to close current and projected competency gaps.

VI. NASA's Recruitment Methods and Initiatives To Improve Them

> The Workforce Plan shall describe:
> the recruitment methods used by the Administration before enactment of this chapter to recruit highly qualified individuals and the changes the Administration will implement after the enactment of this chapter in order to improve its recruitment of highly qualified individuals, including how it intends to use nongovernmental recruitment agencies and Internet technologies.

NASA's recruitment methods involve two key components: conducting accurate analyses to identify *recruitment needs* and developing and implementing sound *recruitment strategies* to address those needs. Both components are critical to success.

Identifying Recruitment Needs

NASA has long recognized that a world-class workforce has been the key to its remarkable achievements and uses all available flexibilities and authorities to ensure that such a workforce is sustained. With an aging workforce and potential significant retirements on the horizon, the Agency has placed great emphasis on developing effective recruitment initiatives and strategies.

To ensure that recruitment efforts are aligned with mission requirements, NASA has undertaken a substantial workforce planning and analysis initiative that will support hiring the right people with the right skills at the right time. A key component of this initiative is the Agencywide Competency Management System (CMS)—a system that compares future competency needs with the knowledge base of NASA's current workforce in order to identify projected shortfalls and surpluses. This system, along with a suite of Web-based data analysis tools, allows managers to get a more accurate picture of the Agency's competency strengths and weaknesses.

As discussed in Section I, the workforce planning tools and the CMS have been, and will continue to be, used to plan for and implement the new authorities provided in the NASA Flexibility Act of 2004. By so doing, NASA can target its use of these authorities appropriately to address the Agency's most critical competency needs.

The workforce planning tools provide NASA with the data it needs to target future recruitment and outreach efforts. The next step is developing the recruitment strategies to address the identified needs.

Developing and Implementing Recruitment Strategies

NASA recognizes that recruitment success is influenced by factors such as the organization's mission, goals, priorities, strategies, resources, and values. In May 2001, the

National Recruitment Initiative (NRI) was established to study Center recruitment strategies and plans and to develop Agencywide hiring strategies and tools that focus on NASA's current and future science and engineering recruitment needs. The NRI report concluded that NASA needed to develop a three-pronged approach to recruitment based on a model that accomplished the following:

- *Focuses on the Candidate*—Research shows that organizations that are able to establish a connection with candidates are more likely to have success in hiring them. NASA has personalized the recruitment process in order to entice candidates to join the NASA team.

- *Leverages Partnerships and Alliances*—As pointed out by organizations such as the National Academy of Public Administration, successful recruiting programs develop year-round relationships with colleges. The payoff for establishing relationships with colleges and professional associations is the opportunity to establish name recognition and market NASA as an employer of choice. To be competitive with other employers, NASA continues to broaden its presence on college and university campuses. NASA Centers are re-establishing recruitment networks and fostering relationships with academia so we become better known as a partner in recruiting top talent.

- *Tailors Recruitment Opportunities*—Recruitment strategies and tools are not one-size-fits-all solutions. Research has shown that workforce motivations are different. For instance, what appeals to engineers is different from what appeals to scientists. Thus, recruitment tools, and the associated marketing, must be tailored to fit the audience.

In implementing the strategies based on that model, NASA has used, and will continue to use, a variety of incentives, authorities, programs, and technology-based processes. Examples of the range of incentives, hiring authorities, and hiring programs that the Agency uses are described below.

- *Recruitment and Relocation Bonuses*—Financial considerations play an important role when recruiting potential candidates. NASA has offered recruitment and relocation bonuses to new hires (freshouts and mid- or senior-level hires) when necessary to attract high-quality employees. The enhanced bonuses provided by the NASA Flexibility Act of 2004 will enable NASA to compete more successfully in attracting and retaining top talent.

- *Salary Above the Minimum Rate*—Another financial incentive that enables NASA to compete more successfully with the private sector is the ability to offer starting salaries above the minimum rate of a grade when the candidate has superior qualifications. The qualifications pay authority provided in the NASA Flexibility Act of 2004 is an extension of this concept, and will provide NASA with a means to make better use of its existing workforce to meet mission needs.

- *Student Loan Repayments*—NASA has taken advantage of the recent authority to repay student loans as an incentive to attract and retain employees.

- *Term Appointments*—The term appointment authority is another tool that NASA uses to provide greater organizational agility. Term appointments have been very beneficial, particularly in supporting programs and projects of limited duration. The enhancements to the term appointment authority provided in the NASA Flexibility Act of 2004 will make the use of term appointments even more effective.

- *Intergovernmental Personnel Act (IPA)*—NASA has long recognized the value of the IPA authority as a means of strengthening the workforce by leveraging outside talent from academia and the nonprofit sector, infusing new ideas and perspectives into the Agency, developing new skills within the NASA workforce, and strengthening mission capabilities. This authority will be even more useful through the legislative provision that permits assignments to be extended beyond 4 years.

- *Student Programs*—NASA makes extensive use of student employment programs as sources of candidates critical to building a workforce of the future. Such programs include the Co-operative Education Program, the NASA Undergraduate Student Research Program, and the NASA Graduate Student Research Programs. The recognition of the importance of building the science and engineering pipeline led to our legislative proposal for the Science and Technology Scholarship Program. This program will allow the Agency to support the development of a high-quality science and engineering workforce by awarding scholarships in return for a commitment to work for NASA after graduation.

- *Federal Career Internship Program (FCIP)*—In December 2000, Federal agencies were given the authority to hire employees under the Federal Career Intern Program—a hiring authority that provides greater flexibility in the recruitment and examining process. NASA has made effective use of this program to meet its human capital needs and used it extensively in its corporate recruitment efforts during the 2003 recruitment campaign.

- *Presidential Management Fellow (PMF) Program*—The Agency has been a strong advocate of the Presidential Management Fellow Program (formerly the Presidential Management Intern Program) and continues to use it as a recruitment source.

NASA expects to continue to use the flexibilities described above, in conjunction with the new authorities provided in the NASA Flexibility Act of 2004, to address the human capital challenges it faces over the coming years.

Using Internet Technology and Nongovernment Recruitment Agencies

NASA makes extensive use of Internet technology to enhance its recruitment strategies and will continue to do so. Our initiatives in this area include the following:

- *NASA's Automated Staffing and Recruitment System (NASA STARS)*—To streamline the lengthy and cumbersome recruitment process that often causes the Agency to lose candidates to the private sector, NASA implemented its automated hiring system, NASA STARS, in FY 2001. This innovation has simplified and expedited the hiring process

by using a computer-assisted rating and referral system, allowing candidates to apply online at *http://www.nasajobs.nasa.gov* and using "push technology" to permit candidates to be automatically notified of NASA vacancies matching their interests.

- *NASA's Automated Job Announcement System*—NASA established a unified NASA JOBS Web site (*http://www.nasajobs.nasa.gov*) to provide easy access to job vacancy information at all NASA Centers. The site is user-friendly and allows job seekers to create up to five personalized job searches using their specific job criteria. The site also provides direct links to information on NASA's mission, student opportunities, and education programs.

- *NASA's Recruitment Web Site*—A team of Center recruitment specialists developed a unified, comprehensive, recruitment-focused Web site (*http://www.nasajobs.nasa.gov/recruit*) designed for NASA managers and employees. The site provides information on recruitment tools and strategies, candidate sources, and an interactive recruitment calendar that allows Centers to advertise their upcoming campus and professional association visits.

NASA has developed more expansive marketing techniques in order to compete in today's environment and appeal to the emerging workforce. Recently, the Agency developed new promotional materials, including CD-ROM business cards with links to the NASA Jobs Web site and a short movie on the history of NASA. In addition, we developed an employment DVD that provides information on what it's like to work at NASA from those who know best—our own employees. Our recruitment materials will be updated to reflect and accommodate the new flexibilities provided in the NASA Flexibility Act of 2004.

NASA stays abreast of services available from nongovernmental recruitment and placement organizations, and engages such outside assistance when appropriate. To encourage interest in NASA career opportunities, the Agency networks extensively with minority, women, and individuals with disabilities professional, scientific, research, and education organizations. In addition, NASA contracts with nongovernmental organizations when appropriate—as the Agency did recently to enhance efforts to increase diversity within the workforce.

Unlike many Federal organizations whose missions are less well-known or exciting, NASA's challenging work is its most successful marketing tool. To attract applicants, NASA uses its most effective recruitment resource—its employees. NASA's talented employees inspire enthusiasm for the work that they do. Employees, particularly scientists and engineers, and senior Agency officials, serve as technical recruiters at on-campus job fairs, minority and professional associations, and a wide variety of other outreach events. Typically, these employees present briefings on the work that they do or provide information on NASA projects that are of interest to the audience. It is through their stories that NASA inspires students and mid-level careerists to join the NASA workforce.

NASA's Corporate Recruitment Strategy

> "NASA will implement an integrated Agency-wide approach to human capital management. This approach will attract and maintain a workforce that is representative of the Nation's diversity and includes competencies that NASA needs to deliver sustained levels of high performance that the Agency's challenging mission requires."
> (NASA's 2003 Strategic Plan)

NASA recently implemented a significant change to its approach to recruitment in developing a Corporate Recruitment Strategy. In partnership with the Office of Education and Office of Equal Opportunity Programs, the Human Resources Office developed a NASA-wide recruitment strategy designed to meet short- and long-term workforce needs based on forecasted competency gaps. The primary focus of this 5-year plan is recruitment of exceptional and diverse individuals with science, engineering, and business management skills and competencies. The Agencywide recruitment strategy allows NASA Centers to share limited resources and identify recruitment opportunities of most benefit to NASA.

Taken together, these objectives and actions are designed to promote an effective and efficient corporatewide recruitment strategy. Improved marketing, stronger retention programs including orientation and mentoring programs, and effective print and electronic advertisement campaigns will strengthen NASA's reputation as an employer of choice. Stronger outreach and capacity building at colleges, universities, and professional associations will increase candidate pools and promote a more diverse workforce. Continuous evaluation of the strategy to assess program success will enable the Agency to continually improve the strategy. The outcome of the strategy will ensure that NASA can continue to build a world-class workforce to achieve its mission.

VII. Workforce-Related Reforms To Resolve the Findings and Recommendations of the CAIB Report

> The Workforce Plan shall describe:
> any workforce-related reforms required to resolve the findings and recommendations of the Columbia Accident Investigation Board, the extent to which those recommendations were accepted, and, if necessary, the reasons why any of those recommendations were not accepted.

With respect to workforce management practices, the Columbia Accident Investigation Board (CAIB) Report includes findings pertaining to systemic cultural and organizational issues, including decisionmaking, risk management, and communication.

NASA accepts the findings of the CAIB, will comply with the Board's recommendations, and embraces the report. This commitment is reiterated in NASA's *Implementation Plan for Space Shuttle Return to Flight and Beyond*—the document that charts NASA's progress toward safe return to flight and implementation of the recommendations and observations of the CAIB. This Implementation Plan, originally released on September 8, 2003, is a living document that is updated periodically (generally every 6 weeks). The most recent version (as of this issuance of the NASA Workforce Plan) is dated April 9, 2004.

Acknowledging the fact that NASA's culture contributed as much to the Columbia accident as any technical failure, NASA has been pursuing an indepth assessment to identify and define areas of improvement and take aggressive corrective action. The Implementation Plan describes actions NASA will undertake in this regard, including the following:

- Create a culture that values effective communication and empowers and encourages employee ownership over work processes.
- Assess the existing safety organization and culture to correct practices detrimental to safety.
- Increase our focus on the human element of change management and organizational development.
- Remove barriers to effective communication and the expression of dissenting views.
- Identify and reinforce elements of the NASA culture that support safety and mission success.
- Ensure that existing procedures are complete, accurate, fully understood, and followed.
- Create a robust system that institutionalizes checks and balances to ensure the maintenance of our technical and safety standards.
- Work within the Agency to ensure that all facets of cultural and organizational change are continually communicated within the NASA team.

To strengthen engineering and safety support, NASA is accomplishing the following:

- Reassessing its entire program and project support structure, with particular focus on checks and balances, line authority, required resources, and funding sources for human space flight safety organizations.
- Restructuring its engineering organizations, with particular focus on independent technical authority for management of technical standards.
- Establishing a new NASA Engineering and Safety Center to provide augmented, independent technical expertise for engineering, safety, and mission assurance. The function of this new Center and its relationship with NASA's programs will evolve over time as we progress with our implementation of the CAIB recommendations.
- Returning to a model that provides NASA subsystem engineers with the ability to strengthen Government oversight of Space Shuttle contractors.
- Ensuring that Space Shuttle flight schedules are consistent with available resources and acceptable safety risk.

To improve communication and decisionmaking, NASA will:

- Ensure that we focus on safety as a core value pervasive in all our mission activities.
- Actively encourage people to express dissenting views, even if they do not have the supporting data on hand, and create alternative organizational avenues for the expression of those views.
- Revise the Mission Management Team structure and processes to enhance its ability to assess risk and to improve communication across all levels and organizations.

To strengthen the Space Shuttle Program management organization, NASA has:

- Increased the responsibility and authority of the Space Shuttle Systems Integration Office in order to ensure effective coordination among the diverse Space Shuttle elements. Staffing for the office also will be expanded.
- Established a Deputy Space Shuttle Program Manager to provide technical and operational support to the Manager.
- Created a Flight Operations and Integration Office to integrate all customer, payload, and cargo flight requirements.

To expand technical and cultural training for Mission Managers, NASA will:

- Exercise the Mission Management Team with realistic in-flight crisis simulation. These simulations will bring together the flight crew, flight control team, engineering staff, the Mission Management Team, and other appropriate personnel to improve communications and to teach better problem recognition and reaction skills.
- Engage independent internal and external consultants to assess and make recommendations that will address the management, culture, and communications issues raised in the CAIB Report.
- Provide additional operational and decisionmaking training for mid- and senior-level Program Managers.

Specific recommendations in the CAIB Report related to workforce management and organizational issues are provided below, with a summary of actions underway by NASA in response to them.

R7.5-1: Establish an independent Technical Engineering Authority that is responsible for technical requirements and all waivers to them, and will build a disciplined, systematic approach to identifying, analyzing, and controlling hazards throughout the life cycle of the Shuttle System. The Technical Engineering Authority should be funded directly from NASA Headquarters and should have no connection to or responsibility for schedule or program cost.

R7.5-2: NASA Headquarters Office of Safety and Mission Assurance should have direct line authority over the entire Space Shuttle Program safety organization and should be independently resourced.

R7.5-3: Reorganize the Space Shuttle Integrating Office to make it capable of integrating all elements of the Space Shuttle Program, including the Orbiter.

R9.1-1: Prepare a detailed plan for defining, establishing, transitioning, and implementing an independent Technical Engineering Authority, independent safety program, and a reorganized Space Shuttle Integration Office. In addition, NASA should submit annual reports to Congress as part of the budget review process on its implementation activities.

A team led by the Associate Administrator for Safety and Mission Assurance has been chartered to develop a detailed plan for defining, establishing, transitioning, and implementing these recommendations to ensure that NASA establishes an organizational structure and culture to operate the Shuttle Program safely and with technical excellence. As part of this effort, the Agency is working with industry and the Department of Defense to benchmark their independent oversight processes.

As a first step, NASA established the NASA Engineering and Safety Center (NESC) to provide augmented engineering and safety assessments. Although located at the NASA Langley Research Center, the Headquarters Office of Safety and Mission Assurance provides the NESC's budget and policy to assure its independence. The NESC is an important effort toward returning the Shuttle to safe flight, but it represents more than that. Its broader objectives include strengthening and expanding NASA's independent safety, mission assurance, and engineering disciplines for all of the Agency's programs.

NASA also has strengthened the role of the Space Shuttle Integration Office to make it capable of integrating all of the projects and elements of the program, including the Orbiter project. The new Shuttle Engineering and Integration Office reports directly to the Program Manager.

NASA is committed to ensuring that the Agency's Safety and Mission Assurance organizations are staffed with exceptional, high-performing engineers, scientists, and technicians. The Agency's recent experience in establishing the NESC provided a valuable opportunity to examine organizational, cultural, or institutional barriers to recruiting and retaining talented individuals for safety and mission assurance positions and to develop innovative solutions to overcome those barriers. In staffing this critical organization, NASA focused on designing appropriate rotational assignments and organizational structures, and conduct-

ing broad-based recruiting with effective marketing to attract individuals with the right set of skills.

NASA will build on the experiences gained in staffing the NESC with high-quality employees and apply those lessons to strengthening the capabilities of Center Safety and Mission Assurance organizations. The next iteration of the NASA Workforce Plan will expand on this concept and address specific approaches, policies, and organization changes that are being developed.

In addition, recognizing that the recommendations, observations, and findings of the CAIB have applicability beyond the Human Space Flight Program, NASA chartered an Agencywide executive team, led by the Goddard Space Flight Center Director, to examine how the CAIB recommendations and findings can be applied across the Agency. The team's report, *A Renewed Commitment to Excellence*, was issued on January 30, 2004. This report recommends actions that need to be taken to achieve the organizational and cultural changes that are necessary for NASA to be a safer, stronger, and smarter organization.

APPENDIX A

NASA WORKFORCE COMPETENCY DICTIONARY

NASA Competency Management System (CMS)

OFFICE OF HUMAN RESOURCES

Issue Date: 02-19-2004
Revision: 4b

PREFACE

PURPOSE

The NASA Competency Management System (CMS) is a collection of business processes and tools that are used to measure and monitor the Agency's corporate knowledge base. A competency is a conceptual representation of a body of knowledge. The competencies are used to categorize the capabilities of an employee, identify the knowledge requirements of a job position, forecast the workforce requirements for a project, and stimulate the interaction and sharing of knowledge across the Agency.

CMS USAGE POLICY

Intended Use

Strategic Human Capital Management: The Competency Management System is primarily a workforce-planning tool that will help the Agency ensure it has the competencies needed for the future workforce. It identifies competencies for employees, job positions, and program/projects. By combining this data with other related information (such as project schedules, mission priorities, allocated resources, etc.), it provides insight into the Agency's workforce capabilities, which enables appropriate decision makers to set guidelines for human capital programs (such as staffing, training, etc.). The program managers can use the competency information to augment other workforce information to align the workforce to the Agency's mission.

Integration of Business Processes: The Competency Management System provides a frame of reference. This allows business processes that are related, to map their objectives and data to competencies. This allows the exchange and integration of information between the processes utilizing a common language.

Employee Development: The Competency Management System provides employees and supervisors an additional avenue to help determine the knowledge areas. This sets the focus for defining the appropriate developmental activities that would further enhance the employee's capabilities.

Expertise Locator: The Competency Management System provides employees, supervisors, project managers, functional offices, enterprise management, and senior leadership the capability to locate expertise within the Agency's Workforce. It provides insight the Agency's Corporate Knowledge Base

Knowledge Management: The Competency Management System can help connect employees with the same or similar competencies into communities of practice. This allows other systems and tools, such as portals, to more easily connect the community with other knowledge management tools (such as Lessons Learned, Technical Documents, etc.) that are similar or related to the competency.

Communication Tool: The Competency Management System provides a mechanism to understand the Agency's Corporate Knowledge Base that enables improved communica-

tion across project, functional, and organizational boundaries in an effort to realize and apply the full capability of the workforce to accomplish NASA's mission by providing a consistent language and framework.

Restrictions and Limitations

Job Selection: The Competency Management System is not designed or used as an Agency employment and selection system. It does not meet, nor is required to meet, the Uniform Guidelines on Employee Selection Procedures (29 CFR 1607). When defining a job, competencies relate to, and can help define, the knowledge requirements for the position. However, there are other qualification factors defined in terms of abilities and skills that are used during the competitive process. [For detailed information about the job selection process, see the NASA HR Desk Procedure on "The NASA Competitive Placement Plan for Positions GS-15 and Below (Including Trades and Labor Positions)"]

Pay Setting: Most employees are in pay systems that are position-based. This means that basic pay is determined by the classification of the duties and responsibilities of the position to a particular grade or pay level. . The intent of the federal pay system is to ensure that there will be equal pay for equal work. Competencies help to define the Knowledge part of the position requirements. Some competencies are required for a position and help to determine grade and pay. However, these competencies are defined and delineated via the job analysis and classification process, NOT through CMS. Other competencies an employee may possess that are not related to his/her position do not impact the classification of the position. [For detailed information about pay setting, see the NASA Desk Guide on "Pay Setting")

Employee Performance Evaluation: An employee`s performance plan will be based on an employee`s work assignments and responsibilities and must contain at least one element that addresses the individual's performance and its relationship to NASA's Strategic Plan. Competencies are a body of knowledge and therefore cannot be used to plan or evaluate employee performance. [For detailed information about employee performance, see the NASA Policy Guide 3430.1A "NASA Employee Performance Communication System (EPCS)"]

Task/Work Assignments: Competency information can provide supervisors with limited information about what an employee may know. It does not capture or communicate the other items that a supervisor would need in order to assign an employee to a particular task or job, such as how the employee applied their knowledge (which projects, products, tasks) how the employee performs, other special skills or capabilities that an employee may possess, availability of the employee, among others. The Competency Management System is not intended to replace supervisor judgment or direct communication with employees. [For detailed information about work assignments, contact your supervisor]

Other: Any application, or use of the competency data must comply with all related NASA HR Policies and Guidelines.

Privacy Act Notice: Records that relate to employees contained in the Competency Management System (CMS) are subject to the Privacy Act and must be safeguarded against unauthorized disclosure in accordance with 14 C.F.R. 1212.605. Unauthorized disclosure of Privacy Act records may result in criminal penalties under 5 U.S.C. 552a(i)(1) and (2).

Disclaimer
The content in this section on the CMS Usage Policy is provided to the reader as a synopsis of how the competency information and implementation relates to selected NASA Human Resource Policies and Procedures, which are governed by extensive Federal Laws, Regulations, and Guidelines. This information does not supplement or supercede any NASA Agency, or Center, HR Policy or desk procedure. For any questions about competency information as it relates to personnel actions please contact the Human Resource Office at your Center.

Business Rules & Guidelines

(1) Guidelines for the number of competencies per position: The intent of the process is to identify competencies that are required for a job position AND that would be utilized most of the time, or are critical knowledge areas for the position. It is not the intent of the system to capture every possible competency that could be used. Every position should have at least one competency identified, and for most positions it is expected there will be anywhere between 2 and 10 competencies assigned. The CMS system has enough fields to accommodate up to 20 competencies for any position, however, it is expected that there will be few positions that will need to be assigned more than 10 competencies.

(2) Guidelines for the number of competencies per employee: Individuals are to identify the areas of knowledge that they have acquired through past education or work experience. However, it is not feasible, nor the intent of this system, to capture everything a person may know. Therefore, the employee should limit and select the competencies that best describe the knowledge areas that they have utilize most often in the present, or in the past. At a minimum, these should include the competencies that they are using in their current job position. Additional competencies should reflect only those bodies of knowledge that employees feel are current enough to be usable, with or without some refresher development, to a maximum of 20 competencies per person.

(3) Rules for Primary Competency: For every job position, one of the required competencies should be designated as a "primary" competency. It should be the one that best describes, or represents, the knowledge that is utilized the most over a given fiscal year. All competencies identified for a job position are considered of equal value. The primary competency is used during the workforce planning process to help simplify forecasting and the data analysis.

(4) Rules for identifying required competencies for specific position types:
- Senior Executive Service (SES) positions should have Leadership (140) as a primary

competency, with secondary competencies to include Business Management (113) and technical workforce competencies as appropriate
- Middle Management positions should have either Business Management (113) or a technical workforce competency as a primary competency, depending upon the nature of the position. If Business Management is chosen as a primary competency, appropriate technical competencies should be included as secondary competencies; conversely, if a technical competency is chosen as primary, Business Management should be included as a secondary competency
- 1st Line Supervisors should have a technical workforce competency as their primary competency and Business Management (113) as a secondary competency
- Technicians should have Engineering and Science Support (11) as the primary competency with other technical competencies as secondary
- Administrative Officers should have Business Management (113) as the primary competency and other competencies as secondary. (Example: Financial Management, Budgeting Management, etc.)
- Secretary positions should have Administrative Support (115) as the primary competency.
- student trainees/co-ops competencies are not required

Any exceptions to these business rules should be reviewed with Center CMS representatives.

(5) Guidelines for Levels of Proficiency: Proficiency is a measurement of an employee's demonstrated level of capability utilizing the associated body of knowledge. It categorizes the depth of knowledge within any single competency or subcompetency. Reference the "Proficiency Guideline Table" in Appendix B.

REVISION HISTORY

REVISION	DATE	COMP ID	CHANGE
4b	2/3/2004		NO CHANGES WERE MADE TO COMPETENCIES Preface was added. Index was added Cross Reference Table was added.
4a	1/21/2004		NO CHANGES WERE MADE TO COMPETENCIES New Competency Groupings replaced the previous hierarchy.
4	7/21/2003	64	Analytical and Computational Structural Methods has been clarified as a research competency and is applicable to structures discipline
		122	Program/Project Management was modified to separate out knowledge associated with program/project analysis (147).

		126	Physical Security was modified to separate out knowledge associated with export control (144).
		130	Occupational and Environmental Health & Safety was expanded.
		132	Facilities Planning and Operations has been renamed and subdivided into 4 new competencies: • Institutional Facilities Planning (145) • Institutional Facilities Operations (146) • Research Facilities Planning (132) • Research Facilities Operations (148)
		138	(new) Nuclear Engineering has been added.
		139	(new) Software Assurance Engineering has been added.
		140	(new) Leadership has been added.
		141	(new) Personal Communication has been added.
		142	(new) Relationship Management has been added.
		143	(new) Fire Protection Engineering has been added.
		144	(new) Export Control has been added.
		145	(new) Institutional Facilities Planning has been added.
		146	(new) Institutional Facilities Operations has been added.
		147	(new) Program/Project Analysis has been added.
		148	(new) Research Facilities Operations has been added.
3			BASELINE – First dictionary approved by the Competency Management System Agency Implementation Team
2			WORKING DRAFT
1	12/12/2002		INITIAL DRAFT

1. Business Competencies

1.1. Business Operations

1.1.1. Administrative Support (ADMSUP) [115]

Knowledge, capabilities and practices associated with administrative and clerical support to a manager and/or organization to facilitate the mission, goals and customer satisfaction. Use knowledge of administrative techniques, tools policies and/or procedures to provide enabling functions such as timekeeping, scheduling, office communications, document generation, and tracking and follow up systems. Integrate knowledge of specialized processes, resources, terminology, with administrative skills to improve efficiency of business operations.

1.1.2. Partnership & Business Development (BUSDEV) [116]

Knowledge, capabilities and practices associated with the effective targeting and acquisition of external partnerships and business opportunities, including funding opportunities for projects and programs Includes an understanding of the Agency's strategic plan, the ability to identify, assess and forecast new business opportunities such as technology transfer, and develop and use appropriate marketing strategies. Requires knowledge of relevant markets, customer needs in those markets, and an ability to recognize and analyze market trends. Involves development of proposals to win business, and management of existing agreements with external entities such as industry, government, university, and international partnerships. Also includes knowledge of Space Act Agreements, and an ability to facilitate and manage partnerships that support Agency strategies, partner requirements and Space Act provisions. Ability to integrate and work with the appropriate elements of the agency's technical and support communities.

1.1.3. Business IT Systems (BUSITSYS) [131]

Knowledge, capabilities and practices associated with computer architectures and computer-based information systems related to business operations and mission support. This competency is based on knowledge comprised from one or more of the following interrelated technologies: computer and other hardware, programming languages, commercial operating systems, web or database systems, network hardware and software, IT security and other technologies that pertain to the acquisition, computation, storage, distribution, reporting, and management of information.

1.1.4. Business Management (BUSMMT) [113]

Knowledge of principles and practices related to managing the internal and external operations of a business unit such as a Center to effectively accomplish mission objectives and goals, achieve customer satisfaction, develop strong relationships with other NASA and external entities, and adhere to agencywide programs, policies, and procedures. Understanding of internal operations and processes, and how to support or modify processes in order to optimize efficiency and information for decision making.

1.1.5. Commercial Technology (COMTEC) [117]

Knowledge and abilities associated with transferring current and future Agency technology to external entities in order to meet broad Agency vision and missions, and

extend the lifecycle and broaden the usefulness of Agency technologies. Involves expertise in business practices pertaining to intellectual property, patents, licenses and partnerships as well as general business knowledge for assessing potential partners. Includes broad understanding of Agency technologies and programs, as well as familiarity with external entities and markets.

1.1.6. Education Programs and Technologies (EDTECH) [137]
Knowledge, capabilities and practices associated with the research and application of education programs, standards, requirements, activities and services relevant to the fields and disciplines of science, technology, engineering, and mathematics (STEM) within the contexts of pre-college, higher education, and non-traditional learning. Includes knowledge of education concepts and principles, curriculum development, infrastructure, audiences, instructional technologies and distance learning tools, and trends in order for NASA to appropriately influence and contribute to national and state education initiatives and requirements through the use of NASA's unique assets. Includes knowledge of NASA Enterprise and Center-based research and technology needs, and ability to align education activities and programs with these needs. Includes knowledge of demographic and geographic dynamics that influence the educational effectiveness and success within the various student and educator communities.

1.1.7. EEO (EEO) [129]
Knowledge, capabilities and practices associated with the application of EEO initiatives and programs. This includes the formulation, delivery and management of EEO systems applied to meet NASA EEO goals and objectives, as well as the knowledge of related public law, NASA directives and policies.

1.1.8. Export Control (EXPORT) [144]
Knowledge, capabilities, and practices associated with complying with federal laws controlling the export of items and technical data. This includes the formulation and implementation of export control policy, plans, and procedures that ensure compliance with federal law. The primary focus of export control it to ensure compliance through programs, education of the workforce, and addressing unique situations in the aerospace environment.

1.1.9. Governmental Affairs (GOVAF) [136]
Knowledge of NASA-related legislation, the legislative process and public affairs as it pertains to NASA. Includes the ability to monitor legislation that is of interest to NASA, monitor NASA-related hearings and markups scheduled before the House and Senate committees and subcommittees that have oversight over NASA, to especially include Authorization and Appropriations subcommittees. Ability to help manage NASA press releases of Congressional interest and identify key members and issues of importance to them. Broad knowledge of NASA programs and specific knowledge of local center programs.

1.1.10. Human Resources (HUMRES) [128]
Apply knowledge and practices of the full range of personnel/human resource func-

tions, such as classification, workforce planning & analysis, employee and labor relations, retirement, benefits, disciplinary actions, recruitment, selection, training, employee development, promotion regulations and procedures, compensation, and personnel information systems. Provide guidance and leadership in the motivation, performance measurement and overall management of the workforce including the design, delivery, implementation and evaluation of programs and processes. Includes understanding of organizational mission, strategy and business objectives as well as various rules, regulations and culture on people and their work.

1.1.11. Inspection, Investigation and Compliance (INSCOMP) [127]
Knowledge of how to provide objective evaluation of Agency standards and operation through use of inspection and investigation techniques and compliance audits. Understanding of how to assess risk, evaluate evidence, design and conduct inquiries such as inspections and investigations, and make recommendations to prevent, detect or solve crime, fraud, waste and abuse and ensure efficient Agency operations. Involves understanding of how to communicate information to constituents, including Agency leadership and management, employees, and Congress.

1.1.12. Legal (LEGAL) [125]
Knowledge, capabilities and practices associated with representation, counseling, advising, researching, performing, and / or supervising professional legal work in the administration of applicable statutes, regulations, Executive Orders, rules, and case law. This includes knowledge of topics such as procurement, claims, agreements, fiscal matters, personnel matters, environmental matters, FOIA, Congressionals, ethics, patents, intellectual property, appeals, and litigation.

1.1.13. Occupational and Environmental Health & Safety (OCCENV) [130]
Knowledge, capabilities, and practice associated with NASA, Federal, and State OSHA health and safety regulations, policies and procedures used to develop and implement mishap and environmental health prevention practices and measures in all NASA work places. These knowledge areas include safety of personnel and equipment during launch vehicle processing, normal and industrial and laboratory operations, special high hazard tests and operations, aviation and space operations, use and handling of materials and chemicals, and design, construction, and use of facilities. Capabilities include ability to develop and analyze policy, manage, and assess the effectiveness of health and safety programs and practices, which are designed to prevent injury to personnel and loss of NASA property in the industrial work environment, and promote the health and well being of employees.

1.1.14. Public Communications & Outreach (PUBLICOMM) [135]
Knowledge, capabilities and practices associated with the assessment, development and execution of public communication and outreach efforts. Knowledge of effective public relations and presentation techniques for representing and expressing the views, work operations and policies of NASA including liaising with and presenting information to a variety of external audiences. Effectively advocates for the Agency through communication of the organization's expertise and contributions, and assessing the effectiveness of past or ongoing efforts. Apply principles and practices of domestic

and international customs, regulations and details to ceremonies or other interaction with distinguished visitors or in public forums. Manage Agency knowledge so it can be accessed where and when needed for communication purposes inside and outside the Agency. This includes public writing and speaking, information collection and dissemination, news broadcasting and writing, media relations, exhibit design, story development, visitor and guest programs, protocols, and concessionaire management.

1.2. Financial Operations

1.2.1. Budgeting Management (BUDGETMMT) [119]

Knowledge of how to apply management knowledge, principles and practices to obtain, utilize, manage financial resources in the workplace to meet program, project or business requirements. Involves maintaining available resources, making resource decisions based on need and availability, and developing and implementing strategies to make rational and well thought-out decisions related to organizational resources. Includes the ability to provide guidance, formulate a budget plan, defend a budget plan, assess budget performance, advocate budget and alternative scenarios and execute a budget plan. Requires knowledge of policies and practices related to Federal, Agency and Installation accounting, and internal business information systems.

1.2.2. Acquisition and Contract Management (CONMMT) [124]

Apply knowledge and practices associated with solicitation, negotiation, development, selection and administration of contracts/services, in compliance with public law, executive orders, Federal regulations and Agency requirements, policies and initiatives. Use knowledge of contracts to review products and services to determine if they are in compliance with contract terms and conditions. Includes ability to assess technical requirements needed to support program and project implementation, and provide technical guidance and direction to contractors to ensure delivery and quality of services and products. Use contract or acquisition instruments and surveillance systems as necessary to ensure contract or acquisition requirements are being met through the life of the contract.

1.2.3. Cost Estimation Analysis (COSTEST) [121]

Knowledge and practices associated with the determination, estimation, and analysis of costs associated with business functions, programs/projects, processes and/or tasks. Includes preparing, justifying and/or managing costs associated with initiatives to set priorities and track expenses in support of organizational objectives. Involves skill with developing and using estimation algorithms that draw on large volumes of technical historical data.

1.2.4. Financial Management (FINMMT) [118]

Understanding of how to apply management knowledge, principles and practices, generally accepted accounting principles (GAAP), and the standards, policies and practices related to Federal, Agency and Installation accounting and financial management to obtain, utilize, and manage resources in the workplace. Ability to develop and implement strategies to maintain and allocate organizational resources rationally and effectively.

1.2.5. Internal Control / Audit (INTAUD) [120]
Knowledge of how to evaluate control systems for financial, administrative, program, and operational activities to provide reasonable assurances that obligations and costs comply with applicable law, that property is funded, and assets are safeguarded; and that revenues and expenditures applicable to operations are properly recorded and accounted for. Involves ability to conduct surveys, studies and other investigations in management operations to assess adequacy of present systems and make recommendations based on analysis.

1.3. Institutional Support

1.3.1. Institutional Environmental Engineering & Management (ENVENGMMT) [133]
Uses knowledge of environmental engineering, chemistry, biology, geology and hydrogeology to maintain a proactive stance regarding environmental stewardship, including protection and restoration of environmental resources such as ground water, surface water, soils, sediments and air. Assesses compliance to environmental standards, regulations, Executive Orders, and directives. Implements proactive programs such as recycling, pollution prevention, affirmative procurement and energy management.

1.3.2. Fire Protection Engineering (FIREPROT) [143]
Knowledge, capabilities and practices associated fire prevention-related tools and their application to systems for minimizing the occurrence or effects of fire. Maintains comprehensive knowledge of applicable NFPA, OSHA, NASA, aerospace and/or prevention industry trends, standards and policies for fire prevention. Demonstrate a comprehensive knowledge of and contributes to resources available in the fire prevention community including NASA, DOD, academia, and industry. Capability to review and assess complex technical documents for their impact on fire prevention work. Maintain a comprehensive knowledge of Life Safety Systems. Capability to provide mitigation strategies for fire protection when requirements cannot be met.

1.3.3. Institutional Facilities Operations (INSFACOPS) [146]
Knowledge of operations and maintenance principals and techniques for real property, technologically complex facilities, and associated systems and equipment. Ability to develop and manage a comprehensive program of facilities management services to sustain and optimize institutional and research and development (R&D) facilities and equipment consistent with codes and regulations, including schedules, tool/equipment operations & maintenance, safety procedures, and reporting/record keeping for key facilities such as wind tunnels and scientific laboratories. Effectively integrate these services to be consistent with the broader objectives, strategies, and program goals of the organization.

1.3.4. Institutional Facilities Planning (INSFACPLAN) [145]
Knowledge of strategic and long-term master planning for institutional and research and development facilities and equipment required to support business operations and current and future program needs. Ability to plan technologically complex sustainable facilities that provide a suitable environment, including logistics, workspace planning, communication infrastructure, and public space. Knowledge of how to develop functional and facility requirements and the associated costs and scheduling, and

coordinates necessary facility engineering to satisfy all functional and regulatory requirements. Devise and implement policies and procedures regarding safety and fire prevention, emergency preparedness, property parking and records space planning.

1.3.5. Institutional Logistics, Supply and Transportation (LOGSUPTRAN) [134]
Knowledge of principles, practices, equipment and tools in the areas of Logistics, Supply and Transportation. Understanding of how to manage and optimize equipment, supplies and transportation systems to provide an infrastructure that enables the agency to operate effectively. Includes management of specifications, acquisition, certification, storage, delivery, lifecycle support, distribution, and disposal of supplies, hardware, materials, equipment, and property (except real estate) and the operation and maintenance of transportation and other equipment used to move materials or passengers. Also includes management of inventories, including government property, equipment and materials provided to employees and contractors, so that the property is accurately accounted for, reported against and disposed of at the end of its useful life. Requires understanding of government regulations regarding property management and disposal, and related contracting terminology and requirements.

1.3.6. Physical Security (PSEC) [126]
Knowledge and practices associated with facilities, personnel and operational security. Ability to develop, implement, and manage processes and programs involving law enforcement, emergency preparedness and fire prevention measures to ensure the security of the facilities and employees. This competency includes the commitment to protect lives, property and operations.

1.4. Professional Development

1.4.1. Leadership (LEADERSHIP) [140]
Use expertise and persuasiveness to influence others to follow a particular path and/or perform to their highest capabilities. Create and communicate a shared-vision by making effective decisions, supporting and developing peers and coworkers, fostering collaboration and fair work conditions, motivating others, and advocating and leading positive organizational change. Excel in personal effectiveness, working with others, communication & advocacy, and management of resources.

1.4.2. Personal Communication (PERSCOMM) [141]
Knowledge, capabilities and practices associated with effective interpersonal and group communication, communication mechanisms such as facilitations, meetings and tools, as well as the general environment for communication. It includes gathering, comprehending and expressing thoughts and ideas in an effective and appropriate manner using the appropriate verbal, non-verbal, listening, writing, reading, facilitation and presentation skills.

1.4.3. Relationship Management (RELATIONSHIP) [142]
Knowledge, capabilities and practices associated with the assessment, development and maintenance of the Center's various stakeholder relationships. This includes building and maintaining alliances (from internal collaboration to external partnerships) as well as ensuring a strong customer-orientation and/or partnership practices in interac-

tions involving internal and external stakeholders, including members of industry, government, internationals, and academia. The primary objective is to employ these capabilities to monitor and help ensure (directly and indirectly) the highest levels of effectiveness and satisfaction possible.

2. Engineering & Technology Competencies

2.1. Systems Engineering

2.1.1. Design and Development Engineering (DESDEV) [8]
Knowledge, capabilities and practices associated with all aspects of the technical design and development process including the development of flight hardware, payloads, technology projects fabrication processes and techniques, concurrent engineering, production assessment, and process verification as applied to aerospace vehicles and systems used in atmospheric and space environments. Includes ability to create models and prototypes, particularly in a laboratory setting, based on research oriented plans and schematics and capability to design the system for safe and reliable development, integration and manufacturability.

2.1.2. Engineering and Science Support (ENGSCISUP) [11]
Knowledge, capabilities and practices associated with supporting engineering and science functions. This support includes laboratory, modeling, manufacturing and analytical activities. Focus is on the abilities of an individual to visualize, plan and execute limited instructions from engineering, in the form of drawings/schematics, written or verbal direction, in order to produce a model, prototype or finished product. The technician's application of tools and apparatus, both physical and analytical, are a key element of this competency.

2.1.3. Integration Engineering (INTEGENG) [9]
Knowledge and capability to integrate all elements into a functioning system or subsystem such as complex flight to flight and flight to ground and facilities systems. Includes knowledge and capabilities required for safe and reliable integration of different elements of a system, schedules, configurations and resources as well as the development of launch, mission, manifest, contigency and long-range plans and responses to externally-driven requirements.

2.1.4. Manufacturing Engineering (MANUFACT) [24]
Knowledge, capabilities and practices to perform concurrent engineering and producibility. Includes knowledge and ability to review design documentation, determine resource requirements for manufacturing activities, research and develop manufacturing processes, plan and manage hardware fabrication and assembly, develop and maintain manufacturing project schedules, and resolve manufacturing related problems.

2.1.5. Mission Analysis and Planning (MAP) [1]
Knowledge and ability to analyze requirements of current and near-term missions. Manage integration of technical elements such as vehicle design, flight trajectories, and operational and ground-based infrastructure requirements in order to meet mission and programmatic objectives.

2.1.6. Process Engineering (PROCENG) [114]
Knowledge, capabilities and practices associated with the development and implementation of safe, efficient, and effective processes to achieve performance excellence in Center operations, development, and enabling functions. This includes the identification, development, mapping, modeling, measuring, and analysis of processes that enable work activities, including their suppliers, inputs, outputs, customers, outcomes, and related decisions. Areas of specialization include queuing theory, function analysis, task analysis, human factors, stochastic methods, advanced statistical analysis methods, optimization algorithms, process simulation modeling (discrete and/or continuous), linear programming, and scheduling and capacity analysis systems.

2.1.7. Systems Engineering (SYSENG) [7]
Knowledge, capabilities and practices associated with defining, developing, integrating and verifying an end-to-end new or existing system, with the objective of optimizing performance, safety and mission objectives. Includes knowledge required for safe and reliable system development/integration. Ability to perform feasibility assessments, provide functional analyses; develop and manage system performance and interface requirements to ensure the resulting system meets all technical objectives; perform systems analysis and trade studies, and oversee systems integration and verification. Includes knowledge of system engineering tools and procedures such as configuration management and integrated schematics for defining interconnection of system parts, documenting and managing system configurations and identifying all required interfaces, and mass properties for determining weight distributions. Assumes a breath of knowledge of many specialty areas, and a conceptual understanding of how the pieces fit together.

2.1.8. Test Engineering (TESTENG) [10]
Knowledge of physics, engineering and manufacturing to test systems or subsystems under development for their functioning, efficacy and conformance to design requirements, or to test prototypes for feasibility. May involve ability to plan, conduct, and evaluate developmental, qualification, and acceptance testing in accordance with NASA, Military or Commercial Specifications of air, space and ground systems, components, piece parts, as well as integrated systems. Includes knowledge of environmental test techniques used to simulate loading conditions such as launch, reentry, orbit, and landing, including vibration, shock, acoustics, contamination, acceleration, electromagnetics, radiation, pressure, thermal, chemical, microgravity and solar vacuum, aerodynamics and temperature and humidity. Includes knowledge required for safe and reliable system development/integration.

2.2. Systems Analysis & Mission Planning
2.2.1. Advanced Mission Analysis (ADVMIS) [89]
Knowledge, capabilities, and practices associated with the conception, development, and planning of advanced missions and systems synthesizing science, commercial, military and exploration requirements and considering feasibility, performance, cost, reliability/safety and environmental effects. Also includes understanding of architecture analysis methods and optimization.

2.2.2. Aerospace Systems Concept Development & Technology Assessment (ASCDTA) [90]
Knowledge, capabilities and practices associated with the development of aerospace vehicle and spacecraft concepts from a systems perspective to satisfy prescribed mission architectures and identify enabling technologies for performance, cost and safety. Knowledge of conceptual design, sizing & synthesis of aerospace vehicles or spacecraft. Knowledge of elicitation from subject matter experts of the potential technology improvements from R&D projects in all the relevant aerospace disciplines.

2.2.3. Mission Flight Design (FLTDSG) [2]
Knowledge and ability to conduct computational analysis of air and space vehicle flight design for mission requirements, including sequencing, trajectory optimization, orbital mechanics, flight mechanics and celestial mechanics. Use flight design modeling and simulation tools that determine optimum trajectory solutions for the appropriate mission and vehicle constraints. Includes in-depth analysis of air borne and ground-based trajectory predictions, automated trajectory planning and modeling and trajectory negotiation and data exchange as well as optimization tools which take into account environmental and design constraints. Involves analysis of flight dispersion variables once trajectories are established.

2.3. Aeronautics

2.3.1. Acoustics (ACOUSTICS) [103]
Knowledge, capabilities, and practices related to interior and exterior noise reduction and acoustic design for advanced aerospace systems, subsystems, and components to meet environmental requirements. Includes knowledge and application of experimental and computational aero and structural acoustics. Inherent in this competency is the capability to determine the influence of acoustic environment on ground observers and vehicle passengers alike, as well as to develop an understanding of its impact on vehicle structural responses, including sonic fatigue. Includes ability to conceive, plan, and implement appropriate experimental and flight test programs that are designed to understand and predict the acoustic environment and to validate advanced active and passive noise control concepts.

2.3.2. Aerodynamics (AERODYN) [101]
Knowledge, capabilities and practices associated with fluid mechanics and flow physics modeling and their application to aerodynamic design for aerospace vehicles and components, such as transport and military aircraft, space transportation and launch vehicles, and propulsion systems and their integration with vehicles. Ability to plan, conduct, interpret and correlate results of experimental investigations and computational fluid dynamics (CFD) analyses to predict aerodynamic performance.

2.3.3. Aeroelasticity (AEROELA) [100]
Research knowledge, capabilities, and practices for investigating aeroelastic phenomena and complex steady and unsteady aerodynamic flow phenomena especially in the transonic speed range, for investigating, developing, and demonstrating novel concepts that prevent aeroelastic instabilities, alleviate adverse aeroelastic responses, reduce loads and vibrations, and exploit the aeroelastic characteristics of aerospace vehicles,

for developing analytical methods that predict the aeroelastic and aeroservoelastic responses of aerospace vehicles, and for conducting unsteady aerodynamic, aeroelastic, and aeroservoelastic wind-tunnel tests.

2.3.4. Aerothermodynamics (AEROTHM) [102]
Knowledge, capabilities, and practices related to aero/aerothermodynamic design for aerospace vehicles and components under various flight conditions including liftoff, ascent, stage separation and reentry. Ability to plan, conduct and interpret results of experimental investigations and analytical/computational fluid dynamics to derive aerothermal environments. Inherent within this competency is also the ability to determine the effects of propulsion system plumes on the vehicle/components performance and environment. Knowledge of high temperature gas physics including molecular and atomic internal energy structure, rate processes, and radiative emission characteristics.

2.3.5. Applied Aerodynamics (APPLAERO) [99]
Knowledge of the aerodynamics of flight vehicles focused on improving aerodynamic performance and stability and control of current and future aircraft. Includes knowledge of areas such as analytical and CFD prediction methods, wind tunnel and flight testing techniques, unsteady and high angle of attach flow phenomena, internal flows, propulsion airframe integration, rotary wing aerodynamics, cavity flows, etc. Aerodynamics phenomena are studied over a broad range of Mach numbers, Reynolds numbers, and flight conditions. Assumes a broad understanding of aerodynamics and engineering disciplines.

2.3.6. Air Traffic Systems (ATS) [108]
Knowledge of Air Traffic Management elements, and their properties and interactions, such as air space and range systems, air traffic regulations, aircraft characteristics, airport structures and systems, and geographic and topographical patterns. Apply knowledge of these elements to the development of new systems and tools to improve the efficiency, effectiveness and capacity of the air traffic system, using advanced distributed modeling techniques to research and test concepts and prototypes.

2.3.7. Flight Dynamics (FLTDYN) [98]
Knowledge, capabilities, and practices associated with research and technology in analytical, computational, and experimental methods to characterize the flight dynamics behaviors of aerospace vehicles.

2.3.8. Simulation/Flight Research Systems (SIMFLTSYS) [110]
Knowledge capabilities and practices used to provide and integrate appropriate real-time hardware/software systems in support of piloted simulators and research aircraft that enable experiments in Flight Dynamics, Guidance/Navigation/Control, Crew Systems and Aviation Operations, Reliable Digital Systems and Electromagnetics.

2.4. Facilities

2.4.1. Architectural Engineering (ARCHENG) [112]
Knowledge of architectural design, architectural/facility evaluation, cost, schedules and formulation of performance requirements and alternative analysis/scenarios for key facilities such as wind tunnels and scientific laboratories.

2.4.2. Research Facilities Operations (RESFACOPS) [148]
Knowledge of operation and maintenance of research facilities, and associated systems and equipment. Includes but is not limited to: knowledge required to develop and manage a comprehensive program of research facilities management services, such as test planning and development, development of operational plans and procedures, data acquisition and analysis, test scheduling, resource planning, development of research facility capability enhancements, reliability centered maintenance, energy conservation, system health monitoring, minor facility modification and repair, etc., to operate, sustain and optimize research facilities and equipment. Includes the ability to effectively integrate these services to be consistent with the strategies and program goals of the organization.

2.4.3. Research Facilities Planning (RESFACPLAN) [132]
Knowledge of strategic and long-term planning for research and development (R&D) facilities and equipment required to support research facility operations for current and future program needs. Knowledge required to develop functional and facility requirements and the associated costs and scheduling. Includes knowledge required to coordinate and incorporate the necessary facility engineering to satisfy all functional, institutional and regulatory requirements. Specialized knowledge of high energy/ high risk systems including but not limited to: high temperature systems, high pressure systems, cryogenic systems, exotic gases, control systems, data acquisition systems, energy transfer systems, laboratory workspace planning, communication infrastructure. Includes abilities to devise and implement policies and procedures regarding risk/hazard mitigation and safety assurance.

2.5. Human and Biological

2.5.1. Bioengineering (BIOENG) [58]
Application of technologies to living systems including such areas as biomechanics, imaging, biomedical transducers, biofluids and sensors.

2.5.2. Biomedical Engineering (BIOMEDENG) [35]
Knowledge of engineering, design, development, analysis and test of biomedical systems such as equipment and tools for maintaining crew psychological and physical health for long-duration missions in space. Involves knowledge of broad array of engineering disciplines, and biomedical research, human factors and space medicine findings and practices. Includes knowledge of operational impacts and sustaining engineering on the systems.

2.5.3. Biomimetics (BIOMET) [59]
Knowledge and capability to research and further study natural processes which have potential to be deciphered, mimicked and adopted in technology applications based on biological systems such as environmental heat sensors, retinal or iris scans or face recognition technology. Also includes capabilities in the area of neural electric machine control.

2.5.4. Crew Systems and Aviation Operations (CSAOPS) [97]
Knowledge, capabilities, and practices associated with research and technology in ana-

lytical and experimental methods for pilot/automation integration, crew station design, and aerospace vehicle operations concepts.

2.5.5. Extravehicular Activity Systems (EAS) [38]
Knowledge of engineering, design, development, analysis and test of EVA systems. Requires knowledge and skills regarding the unique environment and constraints in sending a crewmember into space outside of a vehicle, and expertise in designing and developing spacesuits, tools, mechanisms, and operations that support such an activity. Includes knowledge of operational impacts and sustaining engineering on the system.

2.5.6. Environmental Control and Life Support Systems (ECLSS) [37]
Knowledge, capabilities and practices associated with environmental control and/or life support systems used to protect life in dangerous or insupportive environments for flight or ground operations, including related instrumentation, controls, data acquisition, pneumatics and mechanisms. May include knowledge and capabilities needed for development of advanced and/or regenerative life support, such as how to apply plant physiology and pathology, microbial ecology, molecular biology, biological engineering, chemistry, chemical engineering and landscape ecology to development of advanced, regenerative life support such as air and water recycling, solid waste resource recovery, food sources and thermal environmental control.

2.5.7. Habitability and Environmental Factors (ENVFACT) [39]
Knowledge of practices associated with research of and applying research to the habitability of spacecraft and space-based environments and the environmental effects on humans and other organisms with specific emphasis on barophysiology, microbiology and toxicology and radiation. Knowledge of physical and chemical sciences, including heat and mass transfer, acoustics, radiation, thermodynamics, fluid mechanics, and chemical, biological, metabolic and human factors processes. Ability to integrate and apply this understanding to develop systems and technology to enable humans to live and work safely and effectively in space.

2.5.8. Fundamental Human Factors Research (FUNHUM) [40]
Knowledge of human engineering research methods (e.g. literature search, experiment, operational analysis, observation, survey, protection of research subjects) and activities (e.g., experimental design, planning data collection, data analysis, statistics, and documentation. Knowledge of the effects of environmental, individual, cognitive and organizational factors on the behavior and performance of humans, as well as the associated underlying physiological, psychological and social/organizational drivers that influence human behavior. Includes knowledge of a variety of psychophysical areas such as, but not limited to, biomechanics, perception, cognition, sensory-motor control, communication, decision-making, and teamwork and human-automation interaction. Ability to apply theories, experimentation, analysis and modeling to increase fundamental knowledge about human cognition and performance. Ability to develop human factors principles and guidelines which could be used toward designing technology for human performance in complex aerospace operational environments to reduce errors and increase productivity.

2.5.9. Human Factors Engineering (HUMFAC) [41]
Knowledge and capabilities to apply human factors engineering principles, standards, design guides, regulations, and advisory material to the .design, test, evaluation, operation, and maintenance of systems and processes. Knowledge of the physical and psychological processes, capabilities, skill levels, and limitations of humans, such as the science and practical application of experimental psychology, cognitive psychology, human reliability, anthropometrics, biomechanics, and psychophysiology. Knowledge of hardware and software human-interface design principles, modalities (e.g. physical, visual, auditory, verbal), methods (e.g. field studies, analysis, modeling, prototyping, laboratory experiments, simulations, mockups, database reviews) and tools. The ability to define and analyze human engineering requirements, formulate human performance criteria, develop guidelines, develop system concepts, designs, and prototypes; evaluate human-centered technologies, and develop training curricula for application to processes and systems.

2.6. Chemical

2.6.1. Chemistry/ Chemical Engineering (CHEMENG) [25]
Knowledge, capabilities and practices associated with Chemistry and Chemical Engineering as applied to aerospace systems for ground and flight application, particularly for use in sensors, material sciences, propulsion, environmental, ecological, biological or laboratory processes. This includes an understanding of organic, inorganic, analytical and physical chemistry and their application to a wide variety of research, development, failure analysis, and operational systems or topics and/or principles and practices of chemical engineering.

2.6.2. Pyrotechnics (PYRO) [18]
Knowledge of the composition, nature, applications and handling of devices or assemblies containing or operated by propellants or explosives. Involves design and development of such systems for aerospace applications, as well as study of the safe operation and maintenance of the materials and systems. Includes knowledge of fluid and mechanics, thermodynamics, materials, chemistry and physics, structures, mechanical drawings, manufacturing processes and explosive material properties.

2.7. Computer Sci & Info Technology

2.7.1. Communication Networks & Engineering (COMNETENG) [60]
Knowledge and practices associated with researching and developing air and space communications architectures and networks to meet mission and system requirements, and to research new technology for improving air traffic management and communication between satellites, flightcraft, spacecraft and ground. Includes knowledge of communication systems electronics engineering for sending and receiving signals with different networks, including wireless, digital and radio frequency bandwidths. May involve ability to make effective, efficient, and prudent use of the radio spectrum in the best interest of the Nation, with care to conserve it for uses where other means of communication are not available or feasible.

2.7.2. Computer Systems and Engineering (COMPSYSENG) [80]
Knowledge of the design and development of computers and robots. Involves design

of hardware, software, networks and processes to solve technical problems such as analyzing flight systems and aerospace data. Utilizes advanced technologies such as virtual reality, artificial intelligence, and automation. Includes knowledge of computer programming, electronics, mathematical models, and neural and other networking systems.

2.7.3. Data Acquisition, Management and Storage Systems (DAMSSYS) [83]
Knowledge of design, development and implementation of large-scale scientific data storage, access, retrieval and mining systems or techniques. Includes ability to transfer research algorithms into processing code that produces scientific data products for the science community. Includes knowledge of image methods and procedures for automated feature extraction from large data sets.

2.7.4. Data Visualization (DATAVIS) [87]
Knowledge capabilities and practices associated with extracting information and knowledge from extremely large data sets through interactions with visualization systems. Capabilities include developing and using advanced data visualization systems for data mining, pattern recognition and feature extraction for application to earth and space science data sets, as well as large engineering data sets for aviation and space systems. Also involves knowledge of state-of-the art modeling and simulation techniques and hardware for interpreting data and translating the data into animated images for use in scientific and education contexts. Includes understanding of computer science, digital animation three dimensional modeling, video generation and other data representation techniques. Also involves aesthetic skills in creating renditions of data with the power to communicate meaning.

2.7.5. Intelligent/Adaptive Systems (IASYS) [85]
Knowledge of research and development techniques involving autonomous reasoning, human-centered computing and intelligent systems for data understanding towards mission requirements. Possesses knowledge of the practices associated with creating advanced intelligent, self-monitoring and adaptive computer science systems for use in development of aerospace vehicles (including unmanned systems), enhancement of aerospace flight safety and efficiency, and understanding of scientific data. Includes knowledge of techniques of artificial intelligence, virtual reality, automated software engineering, and collaborative and assistant systems, as well as understanding of vehicle health management

2.7.6. Network Systems and Technology (NETSYS) [81]
Knowledge of how to research and implement high-speed wide area networks, including technology development to allow very advanced networks to allow data, audio and video communication. This includes electrical, optical and wireless transmission, telemetry and modeling, simulation of communication systems, and emulation of flight systems, sensors and data acquisition systems to function in an optimal fashion for distributed science and engineering applications. Involves technical skills used in the development and application of computer networks and Internet technology, including switching/routing technology, network architecture, and network security.

2.7.7. Neural Networks & Systems (NEUNETSYS) [84]
Knowledge, capabilities, and practices of synthesizing practical implementations of artificial neural networks for application to NASA missions, programs, and projects. This includes such applications as machine learning algorithms and pattern recognition systems for intelligent flight control systems, complex spacecraft docking capabilities, and instrument control mechanisms.

2.7.8. Robotics (ROBOTICS) [79]
Knowledge of engineering, design, development, analysis and testing of robotic and robotic/human systems, including telerobotics. Includes knowledge of operational impacts and sustaining engineering on the system.

2.7.9. Software Engineering (SWENG) [82]
Knowledge and ability to apply systematic, disciplines and quantifiable approaches to the acquisition and development of software systems for spaceflight, ground support, airborne and facility applications. Development and management of simulations, tools and integrated software development environments for the design, development, verification, testing, manufacture, operation and maintenance of such systems. Specialized knowledge to predict, evaluate and manage critical performance attributes of software-intense systems such as real-time response and embedded hardware-driven resource limits. Includes knowledge of high-performance computing, graphical user interfaces, networking, data integrity and security.

2.8. Electrical & Electronic

2.8.1. Avionics (AVIONICS) [21]
Knowledge of research and engineering of real-time digital electronic avionics systems that use data acquired from sensors and instruments and processes it to determine status of systems for aircraft and spacecraft for such purposes as flight control, flight path management and vehicle health monitoring. Includes knowledge of design and development of computational hardware and software networks and interfaces, electrical integration, power distribution and electrical systems engineering.

2.8.2. Electro-Mechanical Systems (ELMECHSY) [15]
Knowledge of and ability to design, develop, test, integrate and evaluate electro-mechanical systems such as; gimbals, cryogenic mechanisms, smart structures, and magnetic bearings, solar array drive systems, choppers, shutters, scanning, and focusing mechanisms. Has capability to perform the complete engineering lifecycle on systems for the drive, sensing, and control of precision flight instruments, and spacecraft subsystems.

2.8.3. Electrical and Electronic Systems (ELSYS) [13]
Knowledge of engineering design and analysis, development and research of electrical systems and components for air, space and ground systems and instruments. Includes knowledge of electrical integration (cable design/development/testing) such as electrical / electronic design requirements definition, subsystem and circuit analysis, test procedure development, and safety analysis. Includes knowledge of analog and digital electrical systems engineering, EEE parts, electronic packaging design and tools, reli-

ability and environmental effects, power generation, distribution, storage and conditioning systems. Knowledge of thermal analysis of printed circuit boards and use to analyze data to optimize design of flight electronics.

2.8.4. Flight and Ground Data Systems (FLTGNDSYS) [19]
Knowledge of integration of systems for commanding and monitoring communications for aerospace vehicles, payload flight systems and related ground equipment. Understanding of processing techniques and requirements for housekeeping, health and status, operational and science data for spacecraft and science instruments. Includes knowledge of data computational, acquisition, storage and distribution systems; special purpose analog/digital data handling and unique interface applications software. Assumes broad understanding of IT, electronics and communications disciplines and an ability to integrate the pieces together to optimize the location, design and integration of flight and ground hardware and software.

2.8.5. Control Systems, Guidance & Navigation (GNC) [22]
Knowledge of and ability to develop analytical, computational, and experimental methods for control/guidance algorithms, and apply research to develop requirements for control and instrumentation systems; establish component and systems; and use analytical modeling and simulation tools that determine control dynamic solutions. Knowledge of research and engineering of integrated aerospace vehicle systems for the guidance, navigation, and control and health management of flight vehicles in the atmosphere and space. Includes knowledge of sensors and avionics, flight dynamics, mathematical modeling, experimental methods and a broad array of engineering disciplines.

2.8.6. Micro-Electromechanical Systems (MICELM) [16]
Knowledge, capabilities and practices associated with the research, design, development, test, evaluation, application and manufacture of MEMS technologies, including microfabrication, microsystem design and integration, modeling, and packaging.

2.9. Power & Propulsion

2.9.1. Advanced In-Space Propulsion (ADVPRO) [72]
Research, development, design, testing and evaluation of propulsion technologies, such as nuclear propulsion, and space power generation systems to dramatically improve every aspect of in-space propulsion. Specialty knowledge in specific technologies such as nuclear propulsion, high powered electrical, solar voltaic, fuel cells, solar dynamic, and propellantless propulsion such as electrodynamic tethers and beamed energy.

2.9.2. Airbreathing Propulsion (AIRPRO) [69]
Knowledge of technologies and concepts for airbreathing propelled vehicles in order to enhance the safety of operations, reduce lifecycle costs, contribute to reduced costs of air travel and access to space, and reduce carbon dioxide emissions. Includes knowledge of various engine cycles, flight conditions, efficient mixing and combustion, various materials, and reliable design tools for aerodynamic and propulsion system design and performance prediction, as well as application of combined cycle systems to advanced propulsion techniques.

2.9.3. Hypersonic Airbreathing Propulsion (HAIRPRO) [70]
Knowledge of research and testing activities associated with hypersonic airbreathing propulsion flowpath and its integration with the vehicle concepts. Includes knowledge of the physics of high speed fuel-air mixing and combustion. Ability to plan, conduct, and interpret results of experimental and computational investigations to derive engine performance. Inherent within this competency is also the ability to design and develop engine components (inlet, combustor, and nozzle) and their interaction.

2.9.4. Hypergolic Systems (HYPERSYS) [71]
Knowledge, capabilities and practices associated with hypergolic propellants and propulsion systems. This includes handling characteristics, material properties, system safety, and system unique requirements for the safe and effective test, implementation, and operation of hypergolic systems for research, development, design, analysis, testing and/or evaluation.

2.9.5. Nuclear Engineering (NUCLEARENG) [138]
Knowledge of scientific and engineering principles associated with the safe design and operations of terrestrial and non-terrestrial nuclear reactor systems and radioisotope decay power systems. Knowledge and practice of neutron fission and decay of nuclear material, radioactivity determination/calculation/shielding due to fission and decay of nuclear materials, thermodynamics, nuclear/quantum physics, materials science, operations and control principles of nuclear reactors, simulation of reactor operations, health-physics effects of reactor radioactivity on humans, and probabilistic risk assessment. Ability to develop design concepts for potential nuclear propulsion systems, evaluating proposed designs and doing tradeoffs to determine which concepts can be incorporated into future space missions.

2.9.6. Propulsion Systems & Testing (PROSYS) [68]
Knowledge of conceptual aeropropulsion and aviation systems analysis and testing to assess the benefits of propulsion systems, subsystems and components over all flight regimes from general aviation through space access. Knowledge of the integration of component technologies into conceptual systems. Includes research, design, testing, and evaluation of components systems such as combustors, inlets, nozzles, and turbomachinery, emissions, engine materials and structures, propulsion controls, and propulsion airframe integration. Knowledge of advanced, distributed instrumentation for acquiring improved information in a hostile engine environment. Experience in advanced methods for safe and affordable rocket propellant testing.

2.9.7. Power - Energy Storage (PWRENG) [76]
Knowledge, capabilities, and practices associated with the design, development, test, and evaluation of battery, flywheel, fuel cell, membrane technology and other electrical power storage components and systems.

2.9.8. Power Generation - Photovoltaics (PWRPHO) [77]
Knowledge, capabilities, and practices associated with the design, development, test and evaluation of photovoltaic power generation systems, including electric actuation and solar cell/array systems.

2.9.9. Power Systems (PWRSYS) [75]
Applies knowledge and capabilities involved in the design, development, test, and evaluation of hardware for power generation, storage, conditioning and distribution for all vehicles, spacecraft, and experiments. Inherent within this is a broad knowledge of power sources and technologies and the ability to develop power architectures and integrate all elements into networked systems tailored to their specific environments. Also includes development, test and evaluation of the impact of environments and material on power systems.

2.9.10. Power Generation - Thermal Systems (PWRTHM) [78]
Design development, test, and evaluation of dynamic power systems including thermal and solar dynamic systems.

2.9.11. Rocket Propulsion (ROCPRO) [73]
Knowledge of research and testing activities associated with liquid and solid rocket propulsion. Includes knowledge of combustion devices, cryogenic tanks, engine systems, and propulsion system subcomponents such as gas generators, thrust chambers, turbopump assemblies, valves, propellant ducts, and auxiliary propulsion systems, as well as application of combined cycle systems to advanced propulsion techniques.

2.10. Sensor Systems

2.10.1. Sensors & Data Acquisition - Aeronautics (AEROSEN) [20]
Knowledge, capabilities and practices associated with sensors and data acquisition systems, particularly for use in flight vehicles, payloads and/or associated ground support equipment processes, such as propulsion system sensing or vehicle health management. This includes knowledge of sensing characteristics and properties, data acquisition and data processing characteristics and properties, and system unique requirements for the safe and effective implementation of sensors and data acquisition usage in aerospace systems.

2.10.2. Detector Systems (DETECTSYS) [96]
Knowledge, capabilities, and practices related to the research, design, development, characterization, and application of detectors and detector systems with an emphasis on remote sensing applications. Includes research and development of advanced detectors and detector systems covering a wide spectral range to include UV, visible, IR, and microwave. Also includes the design, development, test, characterization, and integration of detectors and detector systems into a variety of applications with an emphasis on remote sensing systems.

2.10.3. Electron Device Technology (ELDEVTEC) [14]
Knowledge and practices associated in conducting research and development of electron device technology for communications component and systems such as microwave devices, MEMS and MMICs.

2.10.4. Electromagnetics (ELMAG) [12]
Knowledge, capabilities, and practices associated with research and technology in analytical, computational, and experimental methods to quantify and control complex

electromagnetics phenomena to address issues such as electromagnetic interference, electromagnetic compatibility, electrostatic discharge, and advanced integral/conformal antennas. Also includes engineering design of systems and how they will react given electromagnetic fields, compatibility, interference and discharge.

2.10.5. Laser Technology (LASER) [92]
Knowledge of high performance, high reliability lasers and laser systems for measurement of essential planet atmospheric variables including aerosols, water vapor, ozone, wind velocity, green house gasses, ozone, and metrology applications such as ice cap thickness, as well as medicine and manufacturing technologies. Able to apply subspecialty knowledge to research crystal materials and their frequencies, and design highly precise laser systems (such as those tunable and stable to a part per million with high spectral purity, in double pulse format with multibillion shot lifetime) that can withstand both launch and the rigors of deployment in space.

2.10.6. Microwave Systems (MICROSYS) [94]
Applies knowledge and practices associated with the design, analysis, development and test support for devices utilizing advanced technology for instrument (including data system) and communications (including telemetry) applications. Includes knowledge and capability in one or more of the following areas; antenna systems for general electromagnetic components, communications systems for space, suborbital, aircraft, and ground applications, instrument systems (both active and passive) for space, suborbital, aircraft, and ground applications, and systems and components for instrument, communication, telemetry, and radar applications.

2.10.7. Optical Systems (OPTSYS) [93]
Applies principles and practices related to the research, design, development, test, and evaluation and/or operation of optical components and systems, including optical sensors and optical data/image processing. Inherent within this competency is knowledge, capabilities, and practices associated with mechanically and digitally based optical instruments and associated measurement systems required to support siting, construction, assembly or operation of facilities, flight vehicles, payloads, infrastructure, and/or associated ground support equipment and processes. This includes the knowledge of light and optical theory and its application, surveying techniques; measurement equipment operation, care and calibration; measurement data acquisition and data processing techniques; and system unique requirements for the safe and effective implementation of data acquisition in a wide variety of systems.

2.10.8. Remote Sensing Technologies (RST) [95]
Knowledge and ability to conceive, develop and evaluate active and passive remote sensing and detector systems to measure atmospheric constituents including ozone, water vapor, aerosols, and trace species; cloud physical and microphysical properties; wind velocity; and spectral radiation. This includes advanced flight-qualified laser systems, optical components, microwave systems, radiometric sensors, and other remote sensing instruments as well as associated component subsystems, detectors, calibration systems, and data acquisition systems. Assumes a broad understanding of specialty areas such as Laser, Lidar or Optics technologies.

2.11. Structures, Materials & Mechanics

2.11.1. Analytical and Computational Structural Methods (ACMSTR) [64]

Research knowledge, capability, and practices for developing computationally efficient methodologies for structural modeling, analysis, and design, for predicting response, damage tolerance, and residual strength of aerospace structures using nonlinear structural analysis methods and models, for developing validated finite element methods for special purpose computational methods including rapid optimal structural sizing, for developing analytical models for radiation protection and shielding, and for developing multi-sensory, visually immersive simulation and design methodologies for enhanced understanding and collaboration. Involves in-depth understanding of mathematics and computer science.

2.11.2. Advanced Materials and Processing Science (ADVMATSCI) [65]

Research knowledge, capabilities and practices associated with the synthesis, structure, processing and properties of materials, from atomic to macroscopic, including the behavior and mechanisms by which types of materials react to stresses, processes and environments, particularly the harsh environment of space. Includes experimental research into materials such as electronic materials, glasses and ceramics, metals and alloys, lubrication materials, sealants, foams, composites and polymers for improving current and enabling future aerospace applications. . Includes computational research to develop validated structure-property relationship models for all classes of materials. Includes processing, testing, and characterizing these materials to further understanding of how they can be combined or treated to improve the quality and reliability of systems, control defects and prevent contamination of operating systems or components.

2.11.3. Materials Engineering (MATENG) [66]

Knowledge capability and practices associated with research into the characteristics and performance of materials and the design, development and testing of those materials within aerospace structures such as flight systems, ground support and facility systems. Includes the development of math models for assessment of material durability and response to environmental conditions and contaminants. Includes broad knowledge of materials disciplines, including material types such as ceramics, metallics, and polymers as well as tribology or surface science.

2.11.4. Mechanics and Durability (MECDUR) [62]

Research knowledge, capabilities, and practices for quantifying complex aerospace material and structural responses under combined loading and environmental conditions, for investigating the expected lifetime performance, damage tolerance, and reliability of materials and structures, for developing mechanics-based multifunctional materials and structures technologies through characterization, analytical modeling, and simulation, for developing hierarchical models to conceive reliable and safe concepts that are efficient, tailored, high precision, and deployable, and for conceiving, developing, and implementing novel test methods, techniques, and measurement technologies for validating advanced concepts and approaches. Includes the ability to conduct mass properties analysis.

2.11.5. Mechanical Systems (MECSYS) [17]
Knowledge, capability and practices involving the design, development and testing of vehicle and instrument structures, mechanisms deployment systems, associated mechanical ground support equipment and facilities structures. Includes knowledge of mechanical requirements development; mechanical system interfaces among instruments, subsystems, vehicle and ground systems; vehicle and instrument manufacturing and assembly; and vehicle and instrument alignment techniques and qualification testing. Includes knowledge of manufacturing techniques, materials, mechanical and materials standards, parametric computer aided design, mechanisms design, basic structural analysis, and knowledge of the state of best practice for complex mechanical systems.

2.11.6. Non-destructive Evaluation Sciences (NDESCI) [67]
Research knowledge, capabilities, and practices for developing and applying advanced sensors, health monitoring technologies, computational techniques, and NonDestructive Evaluation (NDE) methodologies, e.g., x-ray, ultrasonic, eddy current inspection, to characterize advanced materials and structures, for developing intelligent, autonomous micro and nano-methods for characterization, health monitoring, control, and self-repair of aerospace systems, and for developing techniques and concepts for nondestructive flaw detection, manufacturing process control sensing, and instrument system miniaturization.

2.11.7. Structural Systems (STRSYS) [63]
Knowledge, capability and practices associated with using and modifying advanced analytical and computational methods to design, develop, test and research the characteristics and performance of structures. Includes the development of structural math models for and comprehensive assessment of air, space and ground structures, the analysis of the models to determine structural response to multiple external and internal environmental conditions, and analysis of flight and test data for structural systems. Includes broad knowledge of structures disciplines including structural dynamics, structural mechanics, structural acoustics, mechanisms, electro-mechanical devices, aeroelasticity, impact, damage tolerance and structural life prediction. Also involves research into measurement, instrument and test systems to assess structural characteristics and risks, and ensure system integration.

2.11.8. Structural Dynamics (STUDYN) [61]
Research knowledge, capabilities and practices for developing and analyzing methods to predict, verify and control structural dynamic response for aerospace structures and components including payloads, launch vehicles and propulsion systems. Involves ability to develop high fidelity integrated mechanical three-dimensional models to simulate system behavior and to provide a more thorough understanding of interactions between structures and the motion of mechanisms.

2.11.9. Thermal Structures (THMSTR) [105]
Research knowledge, capabilities, and practices for designing, developing, analyzing, and validating thermal-structural concepts for aerospace systems subjected to extreme operational environments and for developing design technology for thermal-structures

applications and for multiscale optimization of metallic materials, structures, and fabrication processes.

2.12. Thermal/Fluid

2.12.1. Cryogenics Engineering (CRYOENG) [26]

Knowledge, capabilities and practices associated with aerospace cryogenic systems, particularly for use in propulsion, life support, refrigeration and laboratory processes. This includes handling characteristics, material properties, system safety, and system unique requirements for the safe and effective usage of cryogenic fluids for research, development, design, analysis, test, operation and/or evaluation of cryogenic fluids storage and transfer systems for both fuels and oxidizers.

2.12.2. Fluid Systems (FLDSYS) [106]

Knowledge, capabilities, and practices associated with basic fluid physics research (including microgravitational study of complex fluids, multiphase and phase change, fluid dynamics and instabilities, and interfacial phenomena), as well as modeling and development, design, integration, analysis, test, operation and evaluation of aerospace ground and flight closed fluid systems. Knowledge of assessment of requirements, establishment of specifications and evaluation to insure proper function and compatibility of fluid systems hardware/components. Also includes integration of control logic and control systems design to ensure a fully functional process system, and design and development of instruments for imaging fluid leaks, evaluating sensitivity, vibration susceptibility and field usability to ensure safe implementation, particularly for fluid power systems. This requires the basic knowledge and skill of mechanical design, fluid physics, fluid mechanics, component design, and integrated system layouts/designs and evaluation of their capability to satisfy functional and performance requirements.

2.12.3. Fluid Physics (FLUIDPHY) [43]

Employ knowledge of the motion of fluids and the effects of such motion, to the understanding, control and improvement of industrial and natural processes. Areas of research include microgravitational study of complex fluids, multiphase and phase change, fluid dynamics and instabilities, and interfacial phenomena.

2.12.4. Thermal Systems (THMSYS) [104]

Knowledge, capabilities and practices associated with heat transfer, fluid flow, and thermodynamics in the design, development, testing, integration and evaluation of passive and active thermal control systems for spacecraft, instruments, experiments, sensors, aircraft, ground systems, thermal protection systems and facility systems. Includes knowledge and practices in the development of advanced thermal hardware and thermal technology for future spacecraft, instrument, and sensor applications including heat pipes, two-phase heat transfer systems, cryogenic systems, advanced coatings, and heat pumps. Includes knowledge of the development of math models for low and high speed convection, conduction, radiation, ablation and aeroheating.

2.13. Multi-disciplinary R&D

2.13.1. Advanced Analysis and Design Method Development (AADMD) [91]
Enable the mission and system analysis and technology trades for advanced aerospace system concepts. Knowledge of systems analysis methods for use in performing conceptual analysis and design of aerospace systems. Knowledge of multidisciplinary design optimization methods for use in preliminary and detailed engineering analysis and design of aerospace vehicles and spacecraft (including design, manufacturing, and operations).

2.13.2. Advanced Measurement, Diagnostics, and Instrumentation (ADVMDI) [111]
Knowledge, capabilities, and practices associated with research and development, assessment, implementation, and integration of advanced measurement, flow diagnostics, instrumentation to understand and discover flow physics, to develop and validate physical/chemical models, and to support aerodynamic, aerothermodynamic, acoustic, and hypersonic airbreathing propulsion design and analysis of aerospace vehicles in ground facilities and in flight. Inherent within this competency is also the ability to resolve issues arising from test articles, data systems, and integrated measurement systems and their interactions.

2.13.3. Advanced Experimentation and Testing Technologies (AETT) [109]
Knowledge of advanced experimentation and testing philosophies and approaches that provide results to inform research activities in specialized areas such as structures, materials, airborne Systems, aerodynamics, and propulsion. Ability to develop and use specialized facilities and equipment such as wind tunnels, and laboratories. Includes knowledge of how to plan, conduct and interpret experimental test results to understand the interaction of test elements on the design of current and future aerospace vehicles. Also involves ability to develop, manage and enhance test processes to optimize productivity, cycle time, data quality, cost and customer satisfaction.

2.13.4. Mathematical Modeling & Analysis (MMA) [86]
Knowledge, capabilities and practices associated with mathematical modeling, the design of algorithms and applied computational methods, simulation and analysis of physical systems to represent structural, fluid, thermal, dynamic, chemical, or other real phenomena in a quantifiable manner. This includes using manual calculations and computer simulation software. Models can refer to launch vehicle, spacecraft, ground support equipment, handling equipment, and facility/flight interface hardware related physical systems design of algorithms and applied computational methods. This includes capability in the area of quantum computing. Understanding of the physical principle represented in the model is essential to this competency.

2.13.5. Nanotechnology (TINYTEC) [57]
Knowledge of the study of characteristics and properties of extremely small materials for development of new capabilities and applications in support of agency missions, programs and projects such as advanced structures, storage capabilities and computer systems. Includes an understanding of how to apply nanoscience findings, and a broad knowledge of other research and engineering disciplines.

3. Mission Operations Competencies

3.1. Mission Operations

3.1.1. Advanced Technical Training Design (ADVTEC) [3]
Knowledge of state-of-the art practices required to train technical personnel such as flight crew or ground support to accomplish objectives for near-term or futuristic missions. Identify training objectives, design training plans, tools, curricula and simulations using advanced techniques. Involves knowledge of instruction providers and tools, and how to employ and assess these resources.

3.1.2. Mission Assurance (MA) [30]
Knowledge of methodologies and practices such as risk identification, analysis, planning, tracking and control (e.g., Certificate of Flight Readiness process, product management process) used to achieve mission, product or process success. Activities include independent verification of product design requirements, testing validation, critical inspections, facility evaluations, flight safety analysis, development of recommendations, and tracking corrective actions.

3.1.3. Mission Execution (MISEXC) [4]
Knowledge, capabilities and practices associated with the execution of missions, including pre-launch, launch, in-orbit and recovery operations for space flight, or conducting safe, efficient and effective operation of research or training aircraft. Manage command and control activities, payload integration and operations, robotic operations and EVA operations according to mission objectives including the technical activities and real-time decision -making and problem resolution during mission critical operations.

3.1.4. Space Medicine (SPAMED) [36]
Ability to practice medicine involving the unique aerospace environment. Ability to diagnose and provide medical care during pre-flight, in-flight, and/or post-flight operations. Awareness of countermeasures that are in the development and validation process as well as the application of such validated countermeasures.

3.1.5. Vehicle Processing & Payload Integration (VPPI) [5]
Applies knowledge and practices of management, science and engineering to lifecycle of all payload research experiments. Ability to optimize use of existing systems for accomplishment of science objectives, and to determine engineering requirements such as payload support hardware definition, design, fabrication, integration and testing, and operating procedures. Includes ability to integrate payloads into vehicles and determine requirements and predict operating impacts between payloads and vehicles. Ability to test and process payloads, and integrate them successfully on-board the vehicle.

3.1.6. Weather Observation and Forecasting (WOBSFR) [6]
Knowledge, capabilities and practices associated with developing or improving techniques for observing or forecasting local weather conditions in a coastal, semi-tropical environment. Specific capabilities include high resolution in-situ or remote sensing of wind, temperature and humidity; mesoscale meteorological modeling; high-resolution

measurement of atmospheric electric fields and charge; radar meteorology; theoretical or numerical modeling of free electric charge generation and dissipation in clouds; and related areas. It also includes developing concepts of operation for the application of these technologies to Range operations; identifying and evaluating deficiencies in operational weather support for new or existing requirements; understanding the impact of meteorological variables on Range operations and systems; and knowledge of the application of weather data and technologies to the design of operational systems and procedures.

3.2. Quality/Safety/Performance

3.2.1. Quality Engineering & Assurance (QEA) [29]

Knowledge, capabilities, and industry/government standards and practices associated with the assurance of quality (aeronautic and astronautic) for all phases of the mission life-cycle including design, manufacturing, assembly, testing and operations. Capability for planning, defining, and documenting quality requirements for products, processes, and systems that are suitable to the activity, proportional to the risk, and consistent with established NASA guidance, practices, and standards including NASA workmanship standards, NASA parts standards, and NASA recommended practices for contract quality and supplier assessment. Knowledge of ISO 9000 and AS 9100 series of quality standards, and the use of these standards for complex or critical items when technical requirements require control of such things as work operations, in-process controls, and inspection; or attention to such factors as organization, planning, work instructions, documentation control, and advanced metrology.Knowledge of surveillance methods which can range from a one-time test or inspection of a product or service to periodic in process monitoring of on-going contract performance. Ability to assess ongoing performance to ensure the quality of supplies or services received based on the risk, size, time period, and the performance requirements and standards that have been specified. Ability to perform, manage, and/or evaluate the results of operational quality activities (audits, surveys, reports, acceptance data package/test report, etc.) performed by NASA, NASA designated representatives, other delegated agencies, and/or third party certification bodes. Ability to continually improve quality through advocacy and dissemination of advanced quality tools, techniques, technology, practices, policy, procedures, and training (such as practices for ISO 9001/AS 9100, six-sigma, continual improvement, process control, and others).

3.2.2. Reliability & Maintainability Engineering & Assurance (RMEA) [28]

Knowledge, capabilities and practices used to design flight, ground support, and facility systems, equipment and instruments for performing their intended function for a specified interval under stated conditions (reliability) and/or have a defined capability to be restored to operational status following a failure (maintainability). Capabilities include the capacity to: define mission success criteria; define and evaluate compliance with systems/equipment reliability/maintainability requirements, including redundancy requirements; model systems/equipment from a reliability/maintainability perspective, including allocations and predictions; perform and evaluate quantitative and qualitative analyses and assessments, including failure modes and effects analyses/critical items list, probabilistic risk assessments, limited life items, quantitative computations; perform and evaluate statistical analysis, trending, and trade-offs; per-

form and evaluate maintenance analyses, such as reliability centered maintenance techniques; plan, perform and evaluate laboratory testing and engineering analyses; evaluate system/equipment failures to determine root cause and develop corrective actions to prevent similar failures in the future; integrate reliability/maintainability requirements, activities and results with other related disciplines (competencies) such as Safety Engineering and Assurance, Risk Management, Quality Engineering and Assurance, Human Factors, Software Assurance, Acquisition and Contract Management, and Logistics. Also includes availability which can combine the elements of reliability and maintainability in a single parameter."

3.2.3. Safety Engineering and Assurance (SAFENG) [27]
Knowledge of scientific, engineering and management principles for ensuring safety of missions and systems through controlled design, development and operation. Includes ability to use analytical tools such as failure modes and effects analysis, fault tree analysis, probabilistic risk assessment and hazard analysis, and develop technical reports of results, conclusions, and recommendations. Apply criteria and techniques such as safety audits, assessments, inspections, and sampling to identify and eliminate/mitigate hazards and achieve an acceptable level of risk, within the constraints of operational effectiveness and suitability, time, and cost throughout all phases of the system life cycle.

3.2.4. Software Assurance Engineering (SWASSURANCE) [139]
Knowledge, capabilities and practices associated with the planning, organizing, performing, monitoring and directing software assurance activities for software acquired and developed for all phases of the product lifecycle including product concept, acquisition, contractor selection and oversight, requirements, design, implementation, problem reporting, corrective action, verification and validation, testing, operations, maintenance, and retirement. SA practices include software product assurance, process assurance, quality, reliability, safety, security, risk management, verification, validation, and independent verification and validation. Additionally, demonstrate knowledge of current software and systems engineering practices, languages, management, planning, standards, procedures, and recommended processes. Assures that process and product standards are appropriate, implemented correctly, followed, and improved.

4. Program/Project Management Competencies

4.1. Program/Project Management

4.1.1. Program/Project Analysis (PROJANALYSIS) [147]
Knowledge, capabilities and practices associated with formulating, planning, implementing, tracking and evaluating work and its associated requirements and risks, ranging from one-time projects to program-level work. Critical ability is to develop, analyze, and oversee resources, schedule, and management controls needed by the Program/Project manager to achieve the appropriate balance between resources, schedule, and technical objectives. Includes knowledge associated with finance, budgeting, schedule, configuration management, and project controls.

4.1.2. Program/Project Management (PROJPROGMT) [122]
Knowledge, capabilities and practices associated with formulating, planning, implementing, managing, tracking and evaluating work and its associated requirements and risks, ranging from one-time projects to program-level work. Critical abilities are to define customer and stakeholder needs and constraints, reduce ambiguity in objectives, develop and manage an efficient project organizational structure, and apply system architecture principles to develop and manage technical requirements in order to achieve the appropriate balance between resources, schedule, and technical requirements. Includes knowledge associated with system architecture, finance, budgeting, risk assessment, schedule, configuration management, contract technical management, and project controls.

4.1.3. Risk Management (RISKMMT) [123]
Knowledge, capabilities and practices associated with the decision process associated with mitigating or accepting risks. This includes knowledge of fundamental risk management concepts, Continuous Risk Management (CRM) implementation in programs/projects, Risk-Based Acquisition Management (R-BAM) implementation for major procurements that require formal acquisition planning, and ongoing assessment of program/project risk management activities.

5. Science Competencies

5.1. Space Sciences

5.1.1. Astromaterials, Collections, Curation & Analysis (ASTANA) [55]
Apply knowledge of foreign materials, and planetary sciences to the collection of materials from foreign planets, and developing and using appropriate processes for handling and curating them. Includes knowledge and skill in processing the materials to protect Earth system from contamination.

5.1.2. Astrobiology (ASTBIO) [54]
Apply knowledge of biology, chemistry, physics, and other sciences in interdisciplinary experimental, observational, theoretical, and modeling studies of the origin, early development, and transmission of life in or on astronomical bodies and media, including the Earth and its atmosphere, and to determine how and where life arose and evolved on Earth and elsewhere, with due regard to environmental conditions and limits.

5.1.3. Astronomy & Astrophysics (ASTRO) [52]
Knowledge of the fundamental processes of radiation and dynamics for the study of the structure and composition of the Solar System, other planetary systems, stars and stellar systems, galaxies, and the structure and evolution of matter and cosmology. Use a variety of observational methods, data analysis techniques and theoretical models to characterize the physical and dynamical states of celestial objects, determine formation history and predict future evolution. Use physics and chemistry knowledge to conduct observational and theoretical studies and modeling of stars, nebulae, galaxies, and systems of stars and galaxies, and of circumstellar, interstellar and intergalactic media, particles, molecules and radiation fields, in all electromagnetic wavelength ranges. Includes study of specialty areas such as Gamma Ray & X-Ray Astronomy

and Cosmic Ray Astrophysics, in which electromagnetic waves, x-ray emissions and cosmic ray particles provide data for examining the content, structure, origin and evolution of space elements.

5.1.4. Atmospheric Science (ATMSCI) [44]
Knowledge of the fundamental processes of radiation, chemistry and dynamics in the study of the structure and composition of the Earth's atmosphere. Conceive and implement a variety of observational methods, data analysis techniques, and theoretical models to characterize the state of the atmosphere, detect variability and explain the responsible forcing mechanisms, and predict the future state of the atmosphere. Able to develop and implement missions to conduct atmospheric research, and contribute to the development of atmospheric instrument and sensor development. Includes subspecialty knowledge in areas such as Radiation and Climate, Stratospheric & Tropospheric Chemistry.

5.1.5. Planetary Science (PLASCI) [53]
Knowledge of space science applied to conducting experimental, observational, and theoretical studies and modeling of planets, planetary satellites, asteroids, comets, meteoroids, and other objects, media, and particles in the solar system, in order to determine their composition and properties in such areas as atmospheres, magnetospheres, lithospheres, cryospheres, and interiors.

5.1.6. Space Physics (SPAPHY) [51]
Uses knowledge to conduct experimental, theoretical, and/or applied physics and modeling relating to matter, radiation, and their interactions, and ranging from elementary particles and fields to atomic, and nuclear physics, condensed matter physics, optical, gravitational and quantum mechanical, hydrodynamical and magnetohydrodynamical physics and General Relativity, and as applied to the nature and structure of the universe and to chemical, biological, and geophysical systems. Includes specialty areas such as solar physics, involving use of observational and experimental studies to model the Sun and its magnetic activity, characteristics, composition and influence on the Earth and other planetary bodies, as well as space plasma physics, focused on near-Earth environments such as the magnetosphere and its properties.

5.1.7. Terrestrial & Space Environmental Science and Engineering (TSENV) [23]
Knowledge of composition, elements, behaviors and impact of the terrestrial and space environments on the design, development, testing and operation of systems and components for aerospace vehicles and satellites. Involves understanding of atmospheric variables such as wind profiles, turbulence, cloud cover, ice/frost formation, and space characteristics such as ionizing radiation, plasma, meteoroids & supercharged orbital debris, solar and thermal environments. Involves the ability to perform analyses to define the environments, quantify their effect on space craft design, development and operations and perform trade-off studies to optimize performance and assess risk.

5.2. Earth Sciences

5.2.1. Biology and Biogeochemistry of Ecosystems (BBECO) [46]
Apply knowledge of biology, biogeochemistry of ecosystems and the global carbon cycle to research, understand and predict how terrestrial and marine ecosystems change. Research ecosystems as they are affected by human activity, and as they change due to their own intrinsic biological dynamics, and as they respond to climatic variations and, in turn, affect climate. Emphasis is on an understanding of the processes of the Earth system that affect its capacity for biological productivity, explain the role of the biosphere in Earth system function, and promote proactive ecological stewardship. Ability to understand, study and properly document changes in land cover and land use.

5.2.2. Earth Science Applications Research (ESARES) [49]
Use knowledge of Earth systems and measurement technologies for designing research into Earth Science disciplines that have the objective of improving the quality of life on Earth and the longevity of the planet. Apply research to such subjects as resource and disaster management, environmental assessment, human health and safety, food and fiber, infrastructure planning, and environmental quality.

5.2.3. Earth System Modeling (ESMODEL) [50]
Apply understanding of Earth systems to consolidation of scientific findings into integrated representations of atmosphere, ocean, ice land and biosphere systems, with the ability to predict future system trends and evolution of chemical and biological components.

5.2.4. Geophysical/Geologic Science (GEOSCI) [45]
Knowledge of a wide range of disciplines related to the earth's composition, its fluid envelopes, and its position in space. Apply concepts and methods in mathematics, physics, chemistry, and biology to the problems of the atmosphere, the oceans, the solid earth, and the evolution of the planet. Involves ability to conduct far-reaching studies of the origin of the earth and solar system.

5.2.5. Geospatial Science and Technologies (GST) [88]
Applies knowledge and practices of geospatial science and has the ability to utilize and/or develop the tools for acquiring, storing, analyzing, and outputting data in multiple dimensions, as referenced to the earth by some type of real-world coordinate system (eg, a map projection). The ability to reference a geographic location as an important component in the analyses of effects or trends in biological and physical socio-economic resources. Understanding of and ability to use a variety of technology tools, such as geographic information systems (GIS), remote sensing, thematic mapping, image processing, satellite positioning systems such as the Global Positioning System (GPS), and telemetry.

5.2.6. Hydrological Science (HYDSCI) [47]
Knowledge of the scientific study of waters of the earth, especially with relation to the effects of precipitation and evaporation upon the occurrence and character of water in streams, lakes and on or below the land surface. Includes understanding of the hydrologic cycle from precipitation to evaporation or return of the water to the seas, and

application of findings to predict rates and amounts of runoff in rivers, assess required spillway and reservoir capacities, determine soil-water-plant relationships in agriculture and manage water supplies.

5.2.7. Oceanographic Science (OCESCI) [48]
Research into the composition, activities, processes and patterns in the oceans and ocean ice to increase understanding of how the marine environment interacts with the rest of the planet. Includes research on glaciers and ice sheets. Use a variety of data collection methods to collect information about the ocean and mathematically describe and predict ocean processes. Includes ability to translate data into information useful in the understanding and interpretation of the oceans themselves and their connection to other earth systems.

5.3. Physical Sciences

5.3.1. Combustion Science (BOOMSCI) [74]
Employs knowledge, capabilities and practices of study of the science of burning and burning processes, including reaction kinetics and fuels, particularly related to heat transfer, combustion and fluid flow processes by which chemical energy is converted to propulsive power. Utilizes ground based or microgravity experiments to increase basic knowledge of combustion processes

5.3.2. Fundamental Physics (FUNPHY) [42]
Knowledge, capabilities and practices associated with research and application of electromagnetism, continuum and classical mechanics, quantum mechanics, and thermodynamics. May also include studies in materials, cryogenics, acoustics, and electromagnetic fields ranging from DC to X-ray. It also includes the development of sensors necessary to carry out these studies. Involves ability to conduct microgravitational research designed to answer basic questions about the nature and structure of the universe and its chemical, biological and geophysical systems.

5.3.3. Icing Physics (ICEPHY) [107]
Knowledge, capabilities and practices associated with researching and understanding icing physics analysis and testing, atmospheric science, and ice sensing and protection methods.

5.3.4. Nanoscience (TINYSCI) [56]
Knowledge, capability and practices to study and research extremely small materials is such areas as their structure, shape how they act, and how their properties change as their size changes.

5.4. Biological Sciences

5.4.1. Biomedical Research (BIORES) [34]
Involves the capability to research, investigate and characterize the effects of space flight and exposure to microgravity, radiation, and other stresses on physiological functions (e.g., musculoskeletal, cardiovascular, etc.). In-depth understanding of the human body, its physical and chemical make-up and the associated technology and methods to examine the effects of various environments and stresses. Ability to

understand the underlying physiological, behavioral and psychological mechanisms and performance aspects responsible for biomedical and behavioral changes in humans and animals during spaceflight and apply this information to conduct operational and clinical research to develop, validate and implement countermeasures that will ensure the health, safety and performance of flight crews involved during launches, landings, and while in space.

5.4.2. Cell & Molecular Biology (CELLBIO) [31]
Knowledge of and ability to conduct research on basic cellular function and properties such as gene regulation and expression or mechanoreception, that may be directly or indirectly impacted by altered gravitational force and other space-related effects. Includes study of the dynamics of cell behavior and interactions and differentiation in cellular systems within and across organisms under a variety of environmental conditions, such as the physiological changes seen in whole animals in response to the space environment.

5.4.3. Developmental Biology (DEVBIO) [32]
Knowledge of and ability to conduct research on the processes of development, differentiation, and growth in animals and plants at the molecular, cellular, and genetic levels.

5.4.4. Neurobiology (NEUBIO) [33]
Knowledge of and capability to research and provide understanding regarding the structure, function, chemistry and development of the brain. Understanding of the techniques of molecular biology and molecular genetics and various methods for detecting and mapping the activity of individual nerve cells or groups of nerve cells.

Appendix A: Competency ID Number Cross-Reference Table

CompID	Designator	Title
1	MAP	Mission Analysis and Planning
2	FLTDSG	Mission Flight Design
3	ADVTEC	Advanced Technical Training Design
4	MISEXC	Mission Execution
5	VPPI	Vehicle Processing & Payload Integration
6	WOBSFR	Weather Observation and Forecasting
7	SYSENG	Systems Engineering
8	DESDEV	Design and Development Engineering
9	INTEGENG	Integration Engineering
10	TESTENG	Test Engineering
11	ENGSCISUP	Engineering and Science Support
12	ELMAG	Electromagnetics
13	ELSYS	Electrical and Electronic Systems
14	ELDEVTEC	Electron Device Technology
15	ELMECHSY	Electro-Mechanical Systems
16	MICELM	Micro-Electromechanical Systems
17	MECSYS	Mechanical Systems
18	PYRO	Pyrotechnics
19	FLTGNDSYS	Flight and Ground Data Systems
20	AEROSEN	Sensors & Data Acquisition - Aeronautics
21	AVIONICS	Avionics
22	GNC	Control Systems, Guidance & Navigation
23	TSENV	Terrestrial & Space Environmental Science and Engineering
24	MANUFACT	Manufacturing Engineering
25	CHEMENG	Chemistry/ Chemical Engineering
26	CRYOENG	Cryogenics Engineering
27	SAFENG	Safety Engineering and Assurance
28	RMEA	Reliability & Maintainability Engineering & Assurance
29	QEA	Quality Engineering & Assurance
30	MA	Mission Assurance
31	CELLBIO	Cell & Molecular Biology
32	DEVBIO	Developmental Biology
33	NEUBIO	Neurobiology
34	BIORES	Biomedical Research
35	BIOMEDENG	Biomedical Engineering
36	SPAMED	Space Medicine
37	ECLSS	Environmental Control and Life Support Systems
38	EAS	Extravehicular Activity Systems
39	ENVFACT	Habitability and Environmental Factors
40	FUNHUM	Fundamental Human Factors Research
41	HUMFAC	Human Factors Engineering

42	FUNPHY	Fundamental Physics
43	FLUIDPHY	Fluid Physics
44	ATMSCI	Atmospheric Science
45	GEOSCI	Geophysical/Geologic Science
46	BBECO	Biology and Biogeochemistry of Ecosystems
47	HYDSCI	Hydrological Science
48	OCESCI	Oceanographic Science
49	ESARES	Earth Science Applications Research
50	ESMODEL	Earth System Modeling
51	SPAPHY	Space Physics
52	ASTRO	Astronomy & Astrophysics
53	PLASCI	Planetary Science
54	ASTBIO	Astrobiology
55	ASTANA	Astromaterials, Collections, Curation & Analysis
56	TINYSCI	Nanoscience
57	TINYTEC	Nanotechnology
58	BIOENG	Bioengineering
59	BIOMET	Biomimetics
60	COMNETENG	Communication Networks & Engineering
61	STUDYN	Structural Dynamics
62	MECDUR	Mechanics and Durability
63	STRSYS	Structural Systems
64	ACMSTR	Analytical and Computational Structural Methods
65	ADVMATSCI	Advanced Materials and Processing Science
66	MATENG	Materials Engineering
67	NDESCI	Non-destructive Evaluation Sciences
68	PROSYS	Propulsion Systems & Testing
69	AIRPRO	Airbreathing Propulsion
70	HAIRPRO	Hypersonic Airbreathing Propulsion
71	HYPERSYS	Hypergolic Systems
72	ADVPRO	Advanced In-Space Propulsion
73	ROCPRO	Rocket Propulsion
74	BOOMSCI	Combustion Science
75	PWRSYS	Power Systems
76	PWRENG	Power - Energy Storage
77	PWRPHO	Power Generation - Photovoltaics
78	PWRTHM	Power Generation - Thermal Systems
79	ROBOTICS	Robotics
80	COMPSYSENG	Computer Systems and Engineering
81	NETSYS	Network Systems and Technology
82	SWENG	Software Engineering
83	DAMSSYS	Data Acquisition, Management and Storage Systems
84	NEUNETSYS	Neural Networks & Systems
85	IASYS	Intelligent/Adaptive Systems
86	MMA	Mathematical Modeling & Analysis
87	DATAVIS	Data Visualization
88	GST	Geospatial Science and Technologies

89	ADVMIS	Advanced Mission Analysis
90	ASCDTA	Aerospace Systems Concept Development & Technology Assessment
91	AADMD	Advanced Analysis and Design Method Development
92	LASER	Laser Technology
93	OPTSYS	Optical Systems
94	MICROSYS	Microwave Systems
95	RST	Remote Sensing Technologies
96	DETECTSYS	Detector Systems
97	CSAOPS	Crew Systems and Aviation Operations
98	FLTDYN	Flight Dynamics
99	APPLAERO	Applied Aerodynamics
100	AEROELA	Aeroelasticity
101	AERODYN	Aerodynamics
102	AEROTHM	Aerothermodynamics
103	ACOUSTICS	Acoustics
104	THMSYS	Thermal Systems
105	THMSTR	Thermal Structures
106	FLDSYS	Fluid Systems
107	ICEPHY	Icing Physics
108	ATS	Air Traffic Systems
109	AETT	Advanced Experimentation and Testing Technologies
110	SIMFLTSYS	Simulation/Flight Research Systems
111	ADVMDI	Advanced Measurement, Diagnostics, and Instrumentation
112	ARCHENG	Architectural Engineering
113	BUSMMT	Business Management
114	PROCENG	Process Engineering
115	ADMSUP	Administrative Support
116	BUSDEV	Partnership & Business Development
117	COMTEC	Commercial Technology
118	FINMMT	Financial Management
119	BUDGETMMT	Budgeting Management
120	INTAUD	Internal Control / Audit
121	COSTEST	Cost Estimation Analysis
122	PROJPROGMT	Program/Project Management
123	RISKMMT	Risk Management
124	CONMMT	Acquisition and Contract Management
125	LEGAL	Legal
126	PSEC	Physical Security
127	INSCOMP	Inspection, Investigation and Compliance
128	HUMRES	Human Resources
129	EEO	EEO
130	OCCENV	Occupational and Environmental Health & Safety
131	BUSITSYS	Business IT Systems
132	RESFACPLAN	Research Facilities Planning

133	ENVENGMMT	Institutional Environmental Engineering & Management
134	LOGSUPTRAN	Institutional Logistics, Supply and Transportation
135	PUBLICOMM	Public Communications & Outreach
136	GOVAF	Governmental Affairs
137	EDTECH	Education Programs and Technologies
138	NUCLEARENG	Nuclear Engineering
139	SWASSURANCE	Software Assurance Engineering
140	LEADERSHIP	Leadership
141	PERSCOMM	Personal Communication
142	RELATIONSHIP	Relationship Management
143	FIREPROT	Fire Protection Engineering
144	EXPORT	Export Control
145	INSFACPLAN	Institutional Facilities Planning
146	INSFACOPS	Institutional Facilities Operations
147	PROJANALYSIS	Program/Project Analysis
148	RESFACOPS	Research Facilities Operations

Appendix B: Proficiency Guideline Table

- The following table provides a generic set of guidelines. It identifies some basic knowledge measurements that are common across all competencies and professional disciplines.
- To identify an employee's level of proficiency for a specific competency, the employee should be able to demonstrate all the items listed under a single tier column.
- An individual may have greater expertise (which would show under a high tier column) in one or more of the knowledge measurements below. However, for the purposes of this exercise and the current business rules, the employee must accomplish all of the items in the tier column to be considered at that level of proficiency.
- This table is a tool that should be used by the employee and supervisor. However, the set of measurements do not represent an exhaustive list, and the criterion is not perfect. Therefore, an employee or supervisor's assessment may include additional factors that are not represented below. The intent for collecting the data is to identify an individual's depth of knowledge for a given competency that can be compared with others through out the Agency with the same competency, such that a subject matter expert at one Center is on equal knowledge par with a subject matter expert at another Center.
- These guidelines, and the corresponding business rules, may change as the data is analyzed and the overall system matures. For suggestions on improvements to the criteria, please contact the CMS Operation Manager at your Center.

Knowledge Measurement	**Tier 1**	**Tier 2**	**Tier 3**	**Tier 4**
Tools	Demonstrates basic knowledge of and proficiency in the use of discipline-related tools and their outputs.	Demonstrates working knowledge of and high proficiency in the use of discipline-related tools and related outputs.	Demonstrates ability to effectively assess new discipline-related tools and their application to the organization's work.	Demonstrates the ability to develop standards and specifications for new discipline-related tools and their application.
Data Collection and Analysis	Demonstrates ability to compile and analyze data.	Demonstrates ability to summarize data and produce technical outputs.	Demonstrates ability to effectively execute data analysis to determine performance of organization or discipline-related systems, processes and events.	

Sharing Knowledge	Demonstrates willingness to contribute organization or discipline-related knowledge and information to the related community.	Routinely contributes organization or discipline-related knowledge and information to the related community.	Demonstrates comprehensive knowledge of and contributes to resources available in the related community including NASA, DOD, universities, and industry. Demonstrates willingness to and performs as a mentor or coach to other personnel.	Demonstrates ability to serve as an Agency and industry-wide resource and has built a network to facilitate the acquisition of other resources and information.
Safety	Demonstrates awareness of safety procedures and related best practices for applicable work.	Demonstrates knowledge of and applies safety procedures and related best practices to related work.	Demonstrates comprehensive knowledge of and incorporates safety procedures and requirements to related work and organization.	Demonstrates ability to develop and/or modify safety procedures and requirements for related work and organization.
CENTER, NASA and Industry Trends Standards and Resources	Maintains awareness of applicable CENTER, NASA, aerospace and/or industry standards and policies.	Maintains working knowledge of applicable CENTER, NASA, aerospace and/or industry trends, standards and policies.	Maintains comprehensive knowledge of applicable CENTER, NASA, aerospace and/or industry trends, standards and policies.	
Problem Solving	Demonstrates ability to identify work-related problems.	Demonstrates ability to solve simple work-related problems.	Demonstrates ability to develop or change procedures/processes to resolve and/or prevent difficult technical issues.	Routinely provides design concepts, risk management, trouble-shooting and trade-off analysis.

• The table below provides some additional guidelines that can be used for selected competencies, which may be more applicable to certain positions than others (such as engineering, quality safety and assurance, etc.). It is left to the discretion of the employee and supervisor to determine which items may apply to their work situation.

Knowledge Measurement	**Tier 1**	**Tier 2**	**Tier 3**	**Tier 4**
Safety	Demonstrates awareness of safety procedures and related best practices for applicable work.	Demonstrates knowledge of and applies safety procedures and related best practices to related work.	Demonstrates comprehensive knowledge of and incorporates safety procedures and requirements to related work and organization.	Demonstrates ability to develop and/or modify safety procedures and requirements for related work and organization.
General Knowledge and Capabilities	Demonstrates ability to follow prescribed procedures and implement plans. Can effectively write procedures for simple systems. Demonstrates ability to effectively write basic requirements for simple design, test, operational and maintenance procedures. Demonstrates knowledge of basic design, test, operations and maintenance standards and requirements.	Maintains the ability to specify critical requirements for experiments and characteristics for related systems. Demonstrates ability to coordinate and test within a single discipline. Demonstrates depth of knowledge for one or more specific area(s) of specialization or sub-systems. Has participated in discussions of technical issues related to designs during design reviews. Demonstrates proficiency in	Demonstrates ability to design experiments or tests. Develops an area of scientific or engineering expertise. Demonstrates capability to effectively contribute technical inputs to complex forums such as design reviews, SEBs, program reviews and proposals. Has effectively performed as the primary technical interface for customers external to the Center.	Demonstrates technical expertise to represent the Center on Agency-wide, industry and academic working groups, boards and panels.

	Demonstrates ability to coordinate requirements definition for small projects. Attends preliminary and critical design reviews.	reviewing and providing insight into requirements, standards and related documents for research, design or process forums such as SBIR, design reviews, etc. Demonstrates the ability to integrate customer requirements with situational constraints and interfaces. Has effectively performed as an engineer or designer on a multi-disciplinary project team. Has successfully participated on a cross-organizational design, development, or manufacturing team. Demonstrates ability to identify deficiencies in operational processes and tools and propose cost-effective solutions. Demonstrates the ability to perform verification planning and oversight of integration and test at the subsystem level.	Demonstrates skill in overcoming material and system issues in complex systems. Demonstrates thorough knowledge of at least one complete system, including related instrumentation, controls, data acquisition and mechanisms. Demonstrates ability to perform verification planning and oversight of integration and test at the system-level. Demonstrates ability to integrate systems, including related system requirements and interfaces. Demonstrates the ability to review and assess complex technical documents for their impact on work.	

INDEX

T

V

W

APPENDIX B

NASA's Critical Competencies

Alignment with Office of Personnel Management (OPM) Occupational Series

The following chart aligns NASA critical competencies, as defined in the NASA Workforce Competency Dictionary, with OPM occupational series. Occupational series representing administrative support positions have been deleted. Since there is not a one-for-one match between the two sets of definitions, a competency may be associated with several occupational series, and, conversely, an OPM series may be associated with several competencies.

This analysis is based on several factors: (1) comparison of competency definitions with OPM series definitions; (2) comparison of the "primary" competency of a NASA position and the OPM occupational series assigned to that position; (3) identification of the majors of undergraduate and graduate students who are working in specified competency areas; and (4) the concept of interdisciplinary professional positions as explained in OPM's Introduction to Position Classification Standards.

Competencies	Occupational Titles and Series	
Systems Engineering	General Engineer, GS-801	Electronics Engineer, GS-855
	Computer Engineer, GS-854	Aerospace Engineer, GS-861
Integration Engineering	General Engineer, GS-801	Electronics Engineer, GS-855
	Computer Engineer, GS-854	Aerospace Engineer, GS-861
	Physicist, GS-1310	
Test Engineering	General Engineer, GS-801	Electronics Engineer, GS-855
	Electrical Engineer, GS-850	Aerospace Engineer, GS-861
	Computer Engineer, GS-854	Physicist, GS-1310
	Materials Engineer, GS-806	Physical Scientist, GS-1301
Mission Assurance	Aerospace Engineer, GS-861	Materials Engineer, GS-806
	Biomedical Engineer, GS-858	Ceramics Engineer, GS-892
	Electronics Engineer, GS-855	Welding Engineer, GS-894
	Environmental Health Technician, GS-698	
	Quality Assurance Specialist, GS-1910	
Human Factors	Psychology, GS-180	Computer Engineer, GS-854
	Physiology, GS-413	Biomedical Engineer, GS-858
	Biology, GS-401	Physical Science, GS-1301
	Materials Engineer, GS-806	Physics, GS-1310
Nuclear Engineering	Nuclear Engineer, GS-840	Electrical Engineer, GS-850
	Mechanical Engineer, GS-830	Aerospace Engineer, GS-861
	Physicist, GS-1310	

Design and Development Engineering	General Engineer, GS-801 Computer Engineer, GS-854 Materials Engineer, GS-806 Electronics Engineer, GS-855 Aerospace Engineer, GS-861 Physicist, GS-1310
Quality Engineering and Assurance	Environmental Health Technician, GS-698 Aerospace Engineer, GS-861 Quality Assurance Specialist, GS-1910
Business Management	Administration and Program, GS-301 Program Management, GS-340 Administrative Officer, GS-341 Management and Program Analyst, GS-343 Financial Administration and Program, GS-501
Mission Execution	General Engineer, GS-801 Physical Scientist, GS-1301 Aircraft Operation, GS-2181 Flight Engineer, GS-2185 Aerospace Engineer, GS-861
Program/Project Management	Biologist, GS-401 General Engineer, GS-801 Aerospace Engineer, GS-861 Statistician, GS-1530 Medical Officer, GS-602 Electronics Engineer, GS-855 Physical Scientist, GS-1301
Business IT Systems	Human Resources Management, GS-201 Administration and Program Series, GS-301 Telecommunications, GS-391 Financial Management, GS-500 Legal and Kindred Administration Series, GS-901 Computer Engineer, GS-854 Acquisition and Contracting Management, GS-1102 Computer Scientist, GS-1550 Information Technology Management, GS-2210
Budgeting Management	Administration and Program, GS-301 Management and Program Analysis, GS-343 Financial Administration, GS-501 Budget Analyst, GS-560 Medical Officer, GS-602 General Engineer, GS-801
Propulsion Systems and Testing	Mechanical Engineer, GS-830 Nuclear Engineer, GS-840 Physicist, GS-1310 Electronics Engineer, GS-855 Aerospace Engineer, GS-861
Safety Engineering and Assurance	Environmental Health Technician, GS-698 Aerospace Engineer, GS-861

Mission Analysis and Planning	General Engineer, GS-801 Computer Engineer, GS-854 Aerospace Engineer, GS-861
Acquisition and Contract Management	Administration and Program, GS-301 Contracting, GS-1102 Purchasing, GS-1105
Mathematical Modeling and Analysis	Computer Engineer, GS-854 Aerospace Engineer, GS-861 Physicist, GS-1310 Meteorologist, GS-1340 Mathematician, GS-1520 Electronics Engineer, GS-855 Physical Scientist, GS-1301 Geophysicist, GS-1313 Oceanographer, GS-1360 Statistician, GS-1530
Intelligence/Adaptive Systems	Computer Engineer, GS-854 Aerospace Engineer, GS-861
Institutional Facilities Planning and Operations	Administration and Program, GS-301 Materials Engineer, GS-806 Architect, GS-808 Civil Engineer, GS-810 Environmental Engineer, GS-819 Mechanical Engineer, GS-830 Electrical Engineer, GS-850 Electronics Engineer, GS-855 General Facilities and Equipment, GS-1601 Facility Management, GS-1640 Printing Management, GS-1654
Fundamental Human Factors Research	Psychology, GS-180 Physiology, GS-413 Biology, GS-401 Materials Engineer, GS-806 Computer Engineer, GS-854 Biomedical Engineer, GS-858 Physical Science, GS-1301 Physics, GS-1310
Engineering and Science Support	Engineering Technician, GS-802 Electronics Technician, GS-856 Photography, GS-1060 Physical Science Technician, GS-1311 Mathematician, GS-1521 Facility Management, GS-1640 Quality Assurance, GS-1910 Aircrew Technician, GS-2185
Electrical and Electronics Systems	Engineering Technician, GS-802 Electrical Engineer, GS-850 Electronics Engineer, GS-855 Electronics Technician, GS-856

Communications Networks and Engineering	Telecommunications, GS-391 General Engineer, GS-801 Electronics Engineer, GS-855
Advanced In-Space Propulsion	Aerospace Engineer, GS-861 Physicist, GS-1310
Computer Systems and Engineering	General Engineer, GS-801 Computer Engineer, GS-854 Aerospace Engineer, GS-861 Computer Scientist, GS-1550 Electronics Engineer, GS-855
Financial Management	Financial Administration and Program Series, GS-501 Financial Management, GS-505 Accountant, GS-510 Auditor, GS-511
Flight and Ground Data Systems	Electronics Engineer, GS-855
Human Resources	Human Resources Specialist, GS-201
Public Communications and Outreach	Historian, GS-170 Administration and Program, GS-301 Public Affairs, GS-1035 Photographer, GS-1060 Audiovisual Production, GS-1071 Writer and Editor, GS-1082 Technical Writer and Editor, GS-1083 Visual Information, GS-1084 Library Technician, GS-1411 Technical Information Services, GS-1412 Archivist, GS-1420
Legal	Attorney, GS-905 Paralegal Specialist, GS-950 Patent Advisor, GS-1221 Patent Attorney, GS-1222
Advanced Mission Analysis	General Engineer, GS-801 Computer Engineer, GS-854 Aerospace Engineer, GS-861
Advanced Experimentation and Testing Technologies	General Engineer, GS-801 Materials Engineer, GS-806 Aerospace Engineer, GS-861 Physicist, GS-1310 Electrical Engineer, GS-850
Aerodynamics	Aerospace Engineer, GS-861

APPENDIX C

NASA'S Communications Plan for the Workforce Plan and Legislative Authorities

As a part of the Agency's effort to implement the workforce authorities in the NASA Flexibility Act of 2004, NASA will fully consult with its employees and employee representatives, as well as the appropriate congressional committees. NASA will provide the widest dissemination of information and establish mechanisms for feedback in a "One NASA" approach.

Top management attention, focus, and communication are critical to the success of this effort. The Agency is committed to clear and consistent communication, followed by clear and consistent action. The baseline approach to the communication and education phase of the human capital legislation implementation will be characterized by the following:

- Common informational tools/materials targeted for the various stakeholders, including:
    - Human Resources Community—Briefing materials designed to assist in further dissemination of information with emphasis on obtaining buy-in from other stakeholders.
    - Employees and Representatives—Informational packages explaining how the changes will (or will not) impact them.
    - Line Managers—Explanations of legislative flexibilities, emphasizing how they can be used within guidelines to meet different workforce challenges.
- Agencywide collaboration to leverage expertise to communicate and educate in a consistent manner.
- Mandatory use of both technology (Internet Web sites, VITS, media, etc.) and live forums (Town Hall Meetings, Road Shows, etc.) to disseminate information and gather feedback.

NASA's Communications Plan for legislation implementation addresses three critical components essential to successful change management: (1) the tools and methods for communication; (2) the roles and responsibilities of individuals; and (3) the scope and content of the material being disseminated. A Change Management Team, with representatives from all NASA Centers as well as a representative from the International Federation of Professional and Technical Engineers (IFPTE), will ensure that the Communications Plan is executed successfully.

Tools for Communication

Internet Web Site—NASA will develop a readily accessible and centrally managed Human Capital Legislation Web site accessible to all employees. The Web site will contain the draft Human Capital Legislation Workforce Plan, the Public Law authorizing the new authorities, related implementing policies, "ordinary English" information papers, frequently asked questions (FAQs), and other informational tools as appropriate. It also will provide a means to submit written feedback. All feedback and recommendations

will receive fair consideration. The Web site (*http://nasapeople.nasa.gov/hclwp/index.htm*) was established in January 2004.

Seminars, Informational Forums, and Other Tools—NASA Headquarters and the Centers, with the help of the Human Capital Legislation Team, will develop and disseminate a variety of informational products for employees, employee representatives, and managers. This effort will be supplemented by live forums and video teleconferences sponsored by the Legislation Implementation Team in which NASA employees and their representatives can learn about the NASA Workforce Plan, workforce legislation, and related implementing policies, and provide verbal feedback. Examples of various forums that may be used to disseminate information and gather feedback include the following:

- Town Hall Meetings
- Road Shows
- Human Capital Expos
- Boarding Parties (teams of experts)
- "All Supervisors" Forums
- Staff Meeting Presentations
- Executive Management Council Meetings
- Communication Advocacy Group Presentations
- Change Leader Network Presentations
- Media (NASA TV, Center bulletins and newspapers, etc.)

Roles and Responsibilities

Successful change management requires a shared understanding of the roles and responsibilities of the individuals involved in the communication effort.

NASA Executive Managers play a key role in ensuring that the NASA Workforce Plan is widely communicated and that all feedback is given full consideration. Executive Managers include the NASA Administrator, the Agency Human Resources Director, and the Human Resources Officers at the Centers. Key responsibilities in this effort are described below.

NASA Administrator—The NASA Administrator or designee, with the assistance of the Office of Legislative Affairs, will keep the appropriate congressional committees apprised of the Workforce Plan and any changes to it in accordance with the provisions of the NASA Flexibility Act of 2004.

Agency Human Resources Director—The Agency Human Resources Director will provide guidance to Human Resources Officers at the Centers regarding the processes and requirements relevant to developing or modifying the Workforce Plan and implementing the legislative provisions. The Agency Human Resources Director will coordinate with the Center Human Resources Officers in the change management activities associated with implementing the legislation.

Center Human Resources Officers—Human Resources Officers will assist in developing communication rollout plans for their respective Centers that meet the spirit of a "One NASA" approach. Because some communication forums are more effective than others at certain Centers, there may be variance in the resultant communications rollout plans. As a goal, the plans will ensure that all employees and their representatives be provided with the Workforce Plan and implementing policies, have the opportunity to ask questions about them, and be able to provide feedback through both live and other communication forums.

Human Capital Legislation Implementation Team—The Human Capital Legislation Implementation Team will continue to operate throughout the communications and education phases of this activity to convey a consistent message. The team's continued involvement will help to ensure that comprehensive and consistent information is conveyed to the workforce. Among the activities in which the team may engage to achieve these objectives are the following:

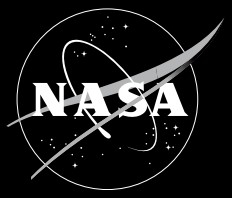
- Providing an Agencywide team of experts to conduct "Boarding Party" presentations at the Centers as needed.
- Conducting video teleconferences with Human Resources Offices to ensure a broad level of understanding within the human resources community so they can assist in the communication and education initiatives as subject-matter experts for their respective Centers.
- Developing common informational materials in the form of informational packets, FAQs, and other materials for distribution to stakeholders.
- Facilitating the process for receiving and considering feedback on the Workforce Plan and implementing policies.

Human Resources Offices Staff—Human Resources personnel at the Centers are encouraged to play a major role. As subject-matter experts, they will be essential in disseminating information on the draft Workforce Plan and in implementing policies and gathering feedback.

Union Engagement—Through NASA's national representatives, AFGE and IFPTE were invited to participate on the Legislation Implementation Team in developing the Workforce Plan, implementing policies, and the communications plan. IFPTE designated a representative to participate on the Legislative Implementation Team, and the individual will continue to participate in the change management activities in the coming months. In addition, Centers will give their local unions the opportunity to bargain on procedures for implementing the new human capital provisions and on any specific provisions that may be in conflict with provisions in their current agreements.

Scope and Content of Material

At a minimum, the materials that will be shared with the workforce through written communications, Web sites, and live forums will include the documents relevant to implementation and understanding of NASA's human capital legislation—the Workforce Plan, the Public Law itself, information papers on the individual workforce authorities, implementing policies and procedures, and FAQs.



National Aeronautics
and Space Administration

NASA Office of Human Resources
Washington, DC 20546

http://nasapeople.nasa.gov

NP-2004-03-347-HQ